Declaration for the Record of Decision Amendment

Site Name and Location

Environmental Conservation and Chemical Corporation, Zionsville, Indiana

Statement of Basis and Purpose

This decision document, together with a Record of Decision dated September 25, 1987, represents the selected remedial action for the Environmental Conservation and Chemical Corporation site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This decision is based on the contents of the administrative record for the Environmental Conservation and Chemical Corporation site. The attached index identifies the items which comprise the administrative record upon which the decision to amend the 1987 Record of Decision, and the selection of the modified remedial action is based.

The State of Indiana concurs in the remedy selected by U.S. EPA for the Environmental Conservation and Chemical Corporation site.

Description of the Remedy

The primary reason for amending the 1987 Record of Decision is to reflect the decision to implement separate, complementary remedies for the Environmental Conservation and Chemical Corporation and Northside Sanitary Landfill sites, instead of the one combined remedy selected in the 1987 Record of Decision, and secondarily, to modify the selected remedy.

For the Environmental Conservation and Chemical Corporation site, the major components of the remedial action, as modified, include:

- Soil vapor extraction, concentration and destruction
- RCRA Subtitle C cap
- Access restrictions
- Subsurface and surface water monitoring
- Contingent subsurface water collection and treatment

Declaration

The selected remedy, as modified herein, is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to this remedial action, and is cost-effective.

This remedy satisfies the statutory preference for remedies that employ treatment that reduce toxicity, mobility or volume as a principal element and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

Because this remedy will result in hazardous substances remaining on-site, pursuant to Section 121(c) of CERCLA, a review will be conducted at the site within five years after commencement of the remedial action and at least every five years thereafter to ensure that the remedy continues to provide adequate protection of human health and the environment.

Date/

Valdas V. Adamkus

Regional Administrator

Region V

Record of Decision Amendment Environmental Conservation and Chemical Corporation

I. LOCATION AND DESCRIPTION

The Environmental Conservation and Chemical Corporation (also referred to as Enviro-Chem, or ECC) and the Northside Sanitary Landfill (NSL) facilities are both on the Superfund National Priorities List, and are located adjacent to each other. On September 25, 1987, a Record of Decision (ROD) was signed which selected a combined remedy for the two sites. Since the time the original ROD was signed, U. S. EPA and the State of Indiana have engaged in negotiations with Potentially Responsible Parties (PRPs) for each site. These negotiations have resulted in separate remedies for each site, individual Consent Decrees for each site, this amendment to the 1987 ROD, and an amendment to the 1987 ROD relating to the NSL site. The purpose of this ROD Amendment is to describe the changes from the remedy selected in the 1987 ROD, as they pertain to ECC.

The Enviro-Chem site is located in a rural area of Boone County, about five miles north of Zionsville and ten miles northwest of Indianapolis. Farmland borders the southern edge of the site and borders the eastern edge of NSL. Residential properties are located to the north and west, within one-half mile of the facility. A small residential community, Northfield, is located north of the site on U. S. 421. Approximately fifty residences are located within one mile of the site.

An unnamed ditch runs north to south between the ECC and NSL sites, along the western edge of NSL, and joins Finley Creek at the southwestern corner of the NSL landfill. Finley Creek runs along the eastern and southern edges of the NSL site and flows into Eagle Creek about one-half mile downstream from the sites. Eagle Creek flows south from its confluence with Finley Creek for ten miles before it empties into Eagle Creek Reservoir. The reservoir supplies approximately six percent of the drinking water for the City of Indianapolis.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The 1987 ROD set forth the history of the ECC site through the date of its issuance. Subsequent to the issuance of the 1987 ROD, the following activities of pertinence have occurred:

1. Both before and after the 1987 ROD was issued, a group of defendants, who in 1983 had entered into a partial settlement of a pending court action, proposed to clean up the Enviro-Chem site

utilizing a soil vapor extraction system. In a letter dated February 1988, U. S. EPA rejected this proposal because, among other deficiencies, the proposal failed to consider the cost of pilot testing or of a granular activated carbon system to treat the extracted vapor.

- 2. Subsequently, this group of defendants undertook a pilot soil vapor extraction study at Enviro-Chem. The results of the study, which was performed in June 1988, indicate that a vapor extraction system, with certain enhancements, may significantly reduce the levels of volatile organics and phenols in the soils.
- 3. These same parties then offered to perform a remedy at the Enviro-Chem site utilizing a closed soil vapor extraction system, with a granulated activated carbon system to treat the extracted vapor. In response, U.S. EPA and the State of Indiana entered into negotiations with these parties concerning the terms under which they might assume responsibility for remediating the site. The proposed Consent Decree and Exhibit A embody those negotiated terms and provide the details of the remedy as it will be performed pursuant to the ROD as amended, herein.

III. COMMUNITY RELATIONS

This ROD amendment, as proposed, was available for public comment for a thirty day period, pursuant to Section 117 of SARA. An Administrative Record containing the documents considered or relied upon in reaching the decision in this Amendment has been available at the Zionsville Town Hall and at the offices of Region V, U.S. EPA. in Chicago.

IV. DOCUMENTATION OF SIGNIFICANT CHANGES FROM 1987 ROD

This ROD Amendment addresses those elements of the remedy which have changed from the 1987 ROD and the requirements and preferences under SARA. Many elements of the original 1987 ROD do not change. Therefore, the findings made in the 1987 ROD remain the same except for the changes described in this ROD Amendment.

The major differences between the remedy selected for ECC in the 1987 ROD and the remedy selected in this amendment are as follows:

- The use of soil vapor extraction technology is selected in this Amendment, instead of the ground water collection and onsite treatment selected in the 1987 ROD.
- The ground water collection and treatment selected in the 1987 ROD would have resulted in cleanup of the site after a long period of system operation, whereas the soil vapor extraction selected in this Amendment will result in cleanup of the site in a significantly shorter period of time.

- There were no on-site cleanup criteria specified in the 1987 ROD; this Amendment specifies Acceptable Soil Concentrations, which are based on ingestion of subsurface water at the site boundary and Acceptable Subsurface Water concentrations based on 1x10-6 risk, on Maximum Contaminant Levels, on Maximum Contaminant Level Proposed Goals, or on Lifetime Drinking Water Health Advisories.
- If the soil vapor extraction does not reduce the specified onsite contaminants to their cleanup standards within 5 years, a subsurface water collection system may be installed, the collected water treated in accordance with Clean Water Act and CERCLA requirements, and disposed of. This contingent activity is similar to a major component of the 1987 ROD remedy, which required collection and onsite treatment of ground water. However, under this ROD Amendment, the interception of the ground water will occur at a point nearer the ECC contamination.

Key portions of the remedy which remain the same from 1987 are summarized here:

- Access restrictions will be implemented to control use of the site.
- A RCRA Subtitle C cap will be installed to prevent direct contact with contaminated soils, and to reduce infiltration. The cap will also enhance the vapor recovery component of the amended remedy.
- The off-site cleanup levels (Acceptable Stream Concentrations) remain the same as in the 1987 ROD, except that a cleanup criterion for PCBs has been added, which represents a 1x10-6 risk level.
- Monitoring of the subsurface water and surface water will be implemented to ensure that no contamination exceeds surface water standards (see Attachment 1).

This ROD Amendment selects separate and distinct remedies for ECC and NSL, which do not encompass the additional area of contamination south of ECC that was discussed in the 1987 ROD. Pre-design investigations indicated that this is a discrete contaminated area, and the cleanup of it will be pursued in another manner.

During the design phases for both the ECC and the NSL remedies, efforts will be made to ensure that the two remedies will be compatible with each other.

BUMMARY

ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION DIFFERENCES BETWEEN 1987 REMEDY AND REMEDY, AS MODIFIED

1987 REMEDY

MODIFIED REMEDY

Combined remedy for ECC and NSL

Separate, compatible remedies for ECC and

NSL

Ground water collection and treatment

Soil vapor extraction

Long-term treatment of ground water

Removal of source of contamination by reducing concentrations of organic chemicals to cleanup levels within 5

years

No on-site cleanup criteria

Acceptable Soil Concentrations and Acceptable Subsurface Water Concentrations

established

No additional remedial requirements if cleanup standards not achieved

Subsurface water collection and treatment instituted if soil vapor extraction does not achieve cleanup levels in 5 years

Figure 1 shows some components of the remedial action selected in this ROD Amendment.

v. Description of modified remedy

The technical attachment to the Consent Decree (Exhibit A) provides details regarding the remedial action selected in this ROD Amendment. The remedial action consists of the following general components:

- Soil vapor extraction, concentration and destruction
- RCRA Subtitle C cap
- Access restrictions
- Subsurface and Surface Water Monitoring
- Contingent subsurface water collection and treatment

Soil Vapor Extraction, Concentration and Destruction

The objective of the soil vapor extraction activity is to remove and destroy volatile organic compounds and selected base neutral/acid organics from the soils through a series of injection and extraction trenches. Operation of the soil vapor extraction system will be terminated when the Acceptable Soil Concentrations, as shown in Attachment 1, and discussed below, are achieved and verified as specified below.

The 1987 ROD selected Acceptable Stream Concentrations as ARARs for off-site subsurface water and for surface water. In addition, a cleanup level for PCBs has been added, which represents a 1x10-6 risk level. Achievement of the Acceptable Stream Concentrations for off-site subsurface water and surface water are also required in this ROD Amendment.

Because this ROD Amendment adds a source removal component, additional standards and regulations are applicable or relevant and appropriate. To confirm that the required level of cleanup of onsite soils has occurred, this ROD Amendment establishes Acceptable Subsurface Water Concentrations which must be met in on-site till wells, and Acceptable Stream Concentrations which must be met in off-site subsurface water and surface water.

Those Acceptable Subsurface Water Concentrations specified herein are either risk-based standards, Maximum Contaminant Levels, Maximum Contaminant Level Proposed Goals or Lifetime drinking water health advisories. The Acceptable Subsurface Water Concentrations specified in Attachment 1 will have to be met in on-site till wells as part of the post soil cleanup verification required to shut off the soil vapor extraction system. In addition, these cleanup levels form the basis for the Acceptable Soil Concentrations.

The Acceptable Soil Concentrations will have to be met in on-site soil samples as part of the post soil cleanup verification required to shut off the soil vapor extraction system. They are based on ingestion of subsurface water at the site boundary, and are calculated from the Acceptable Subsurface Water Concentrations, assuming a dilution of leachate to subsurface water of 1:196, and using established partition coefficients. The ratio of leachate to subsurface water is based on Appendix C of the ECC Remedial Investigation report.

Acceptable Soil Concentrations based on ingestion of soil were considered, but were eliminated. For each parameter showing an Acceptable Soil Concentration in Attachment 1, the standards based on subsurface water ingestion are significantly lower than the standards based on soil ingestion. Because the site will be covered with a Subtitle C cap and direct contact with the soil will be prevented, the pathway of most concern is through the subsurface water.

Achievement of the Acceptable Soil Concentrations shown in Attachment 1 will be verified when each of the following is met: (1) soil vapor collected from restarts of the system show calculated soil vapor concentrations in equilibrium with the Acceptable Soil Concentrations; (2) on-site till wells show compliance with the Acceptable Subsurface Water Concentrations, also shown in Attachment 1; and (3) soil samples collected onsite show compliance with the Acceptable Soil Concentrations.

When verification has been demonstrated, operation of the soil vapor extraction system will be terminated. If the Acceptable Soil Concentrations are not met within five years, U.S. EPA may require implementation of the leachate/subsurface water collection and treatment system.

RCRA Subtitle C Cap

The cap placed on the site will have multiple layers and will comply with the requirements of Subtitle C of the Resource Conservation and Recovery Act. The cap will prevent direct contact with contaminated soils, reduce infiltration, and enhance the soil vapor extraction system.

Access Restrictions

Access restrictions will consist of those specified in the 1987 ROD.

Subsurface and Surface Water Monitoring

The purpose of the subsurface and surface water monitoring is to detect the presence of the volatile organic compounds, base neutral/acid organics, PCBs, and heavy metals specified in Attachment 1 in the subsurface and surface water during and after soil vapor extraction, and to provide information to determine the effectiveness of the soil vapor extraction program.

Once the Acceptable Soil Concentrations have been verified, and the soil vapor extraction system has been shut off, sampling of off-site till wells, on-site till wells, off-site sand and gravel wells, and surface water will be conducted for seven years on a semi-annual basis.

If, during the seven years of monitoring, cleanup levels are exceeded, construction of a ground water collection trench and the treatment of the collected ground water will occur. This action is substantively identical to the component of the 1987 remedy requiring construction of a french drain, onsite treatment of the collected ground water, and discharge pursuant to an National Pollutant Discharge Elimination System permit to Finley Creek. This amended remedy contemplates a more flexible approach to this activity, however, in that the trench may be located in closer

proximity to the contaminated area, and the collected ground water may be sent to a publicly owned treatment works, consistent with applicable law and regulations.

Table 1 is a summary comparison of the 1987 ROD and the 1989 ROD Amendment relative to the Agency's nine evaluation criteria.

VI. STATUTORY DETERMINATIONS

U.S. EPA has determined, and the Indiana Department of Environmental Management concurs, that the remedy selected in this ROD Amendment satisfies the statutory requirements specified in Section 121 of SARA to protect human health and the environment; attain ARARs; utilize permanent solutions and alternative treatment technologies to the maximum extent practicable, and to provide for a cost-effective response.

Protection of Human Health and the Environment

The remedy selected in this ROD Amendment will eliminate the migration of contaminants in the subsurface water and will prevent their discharge into the Unnamed Ditch and Finley Creek. This will be accomplished by removing organic chemicals from the soil through soil vapor extraction.

Some short term air and water releases may occur during the construction of the soil vapor extraction system. Engineering controls will be employed to minimize the releases, in accordance with any applicable laws and regulations.

Attainment of Applicable, or Relevant and Appropriate Requirements

Section 121(d) of SARA requires that remedial actions meet legally applicable or relevant and appropriate requirements (ARARS) of other environmental laws. These laws may include: the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), the Clean Air Act (CAA), the Toxic Substances Control Act (TSCA), the Safe Drinking Water Act (SDWA), and certain State laws which have stricter requirements than the corresponding Federal law. A "legally applicable" requirement is one which would legally apply to the response action if that action were not taken pursuant to Section 104 or Section 106 of CERCLA. A "relevant and appropriate requirement" is one that, while not legally applicable to the remedial action, addresses problems or situations sufficiently similar to those encountered at the site that their use is well suited to the remedial action.

The discussion contained in the 1987 ROD pertaining to ARARs continues to be pertinent to the amended remedy. The method for achieving compliance with those ARARs, though, has been modified.

The following is a description of the ARARs for the amended

components of the remedy and an explanation of how this amended remedial action meets those requirements:

1. RCRA Closure/Post Closure Requirements.

The amended remedy will satisfy closure and post-closure requirements of RCRA and the analogous State of Indiana requirements applicable to hazardous waste landfills.

The 1987 remedy specified a RCRA Subtitle C cap, a french drain, ground water collection and treatment, and 30 years of ground water monitoring. The amended remedy herein provides for the utilization of enhanced soil vapor extraction technology to substantially reduce the levels of contaminants remaining onsite, construction of the Subtitle C cap, and 7 years of surface and subsurface water monitoring once soil cleanup criteria have been verified. It also provides for construction of a subsurface water collection trench if the monitoring indicates contaminants are present above cleanup levels. This is, in essence, the "corrective action" which would be required if compliance monitoring disclosed the need for same under RCRA.

The Indiana Department of Environmental Management, which is authorized to administer RCRA, has determined, through its Commissioner, that utilization of soil vapor extraction to significantly reduce contamination in soil at the site warrants the contingent elimination of the french drain and reduction of the time period for post-closure ground water monitoring. The U.S. EPA hereby similarly determines that this modification complies with RCRA. The RCRA regulations applicable to closures of hazardous waste landfills are found at 40 CFR 265.110, et seq. Section 265.117 provides that post-closure monitoring must continue for 30 years, but that,

"Any time preceding closure of a hazardous waste unit,...
the Regional Administrator may:

(i) Shorten the post-closure care period applicable to the hazardous waste management unit, if all disposal units have been closed, if he finds that the reduced period is sufficient to protect human health and the environment (e.g., leachate or ground-water monitoring results, characteristics of the hazardous waste, application of advanced technology, or alternative disposal, treatment, or reuse techniques indicate that the hazardous waste management unit or facility is secure);

It is the determination of U.S. EPA and the State of Indiana Department of Environmental Management that use of soil vapor extraction, construction of the cap, and the tripartite verification of soil cleanup, is sufficient to protect human health and the environment, so as to justify shortening the compliance

monitoring period to seven years from the date that soil cleanup has been verified. This determination is, in part, based on the fact that those contaminants which will not be significantly reduced by use of soil vapor extraction, are relatively insoluble and immobile, and therefore unlikely to migrate into the subsurface water. It is further based on the finding that soil vapor extraction will significantly reduce the volatile organic compounds and other contaminants which do migrate into and with ground water.

The soil vapor extraction remedy selected herein is both "innovative" and "advanced". Its innovative aspect is a function of the use of injection and extraction trenches, with a cap, which produces a closed system. It is advanced in that it will utilize granular, activated carbon to remove the contaminants from the vapor.

Moreover, this amended remedy selects a backup component, implementation of a subsurface water collection and treatment procedure similar to the french drain specified in the 1987 ROD, if sample results disclose contaminants at levels above the subsurface and surface water cleanup levels during the seven year compliance monitoring period. The collected subsurface water would be discharged pursuant to an NPDES permit, as described in the 1987 ROD, sent to a publicly owned treatment works, or otherwise disposed of, in a manner which complies with applicable or relevant and appropriate laws and regulations, including the Clean Water Act.

2. On-site Soil and On-site Subsurface Water

As described above, the Acceptable Soil Concentrations are the cleanup levels for on-site soils, and the Acceptable Subsurface Water Concentrations are the ARARs for on-site subsurface water. Both the Acceptable Soil Concentrations and the Acceptable Subsurface Water Concentrations determine the level of cleanup on-site. In order for the soil vapor extraction system to be shut off, and additional remedial measures not be required, these cleanup levels/ARARs will have to be met.

3. Off-site Subsurface Water and Surface Water

The Acceptable Stream Concentrations specified in Table 1 of the 1987 ROD remain the ARARs for off-site subsurface water and surface water. In addition, a cleanup level for PCBs has been added, which represents a 1x10-6 risk level. The remedy selected in this ROD Amendment will meet or exceed these ARARs.

4. Subsurface Water Protection

The subsurface water from underneath Enviro-Chem generally flows to the southeast and discharges into the Unnamed Ditch. The removal of organic chemicals from the soil, and the subsequent prevention of contaminant migration are consistent with U.S. EPA's Ground Water Protection Strategy. In addition, the State's drinking water and industrial water standards would not be jeopardized thus adhering to Indiana's nondegradation policy.

5. On-Site Construction Activities

The on-site construction activities at Enviro-Chem may create fugitive dust. Any precautions required by state or other applicable laws will be taken during construction to minimize fugitive dust emissions.

Cost-Effectiveness

The modified remedy selected in this ROD Amendment is as protective as, and offers greater long-term effectiveness than the 1987 ROD remedy. In the Feasibility Study completed at the time of the 1987 ROD, the cost of the combined Northside/Enviro-Chem remedy was estimated to be \$33.9 million. The modified remedy discussed in this ROD Amendment for ECC alone is estimated to cost at minimum \$5 million and at most, \$9 million. The total cost of the separate remedies for Northside and Enviro-Chem is now estimated to be between \$30 and \$39 million. The modified remedy selected in this ROD Amendment contains additional remedy components, as discussed in Section V; the modified remedy is a cost-effective solution.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable, and Preference for Treatment as a Principal Element

If the soil vapor extraction program selected in this ROD Amendment is successful, the concentrations of organic chemicals in on-site soils and subsurface water will be permanently reduced to levels which are below those shown in Attachment 1. If the soil vapor extraction program is not successful within the required timeframe, subsurface water will be collected and treated, preventing the migration of contaminants off-site.

VII. FUTURE ACTIONS

The anticipated Remedial Design and Remedial Action schedule is attached as Figure 2.

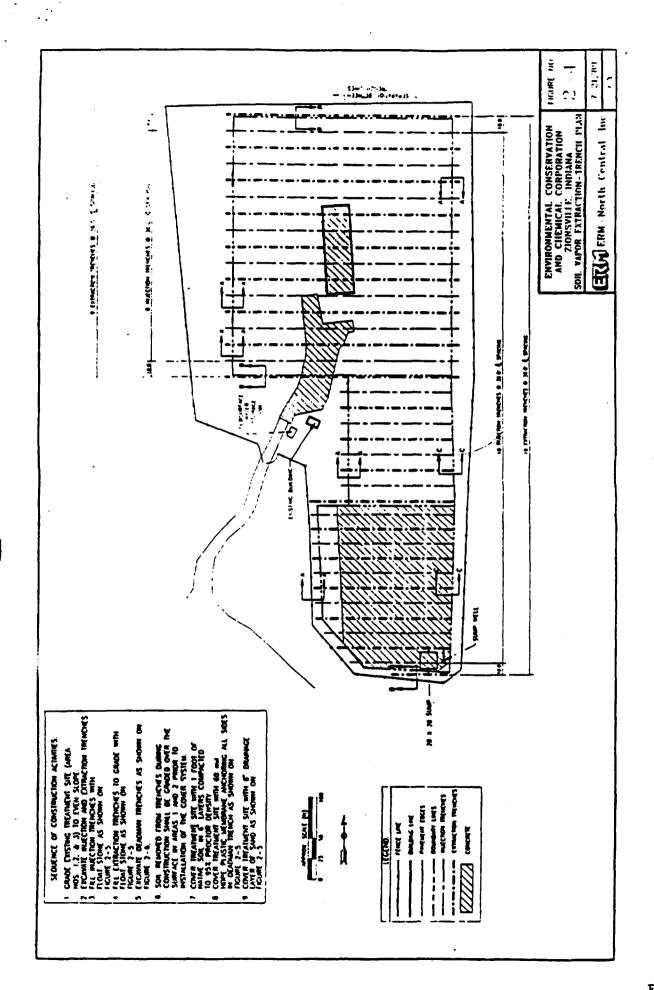


Figure 1

TABLE 3-1 (Page 1 of 2)
SITE-SPECIFIC ACCEPTABLE CONCENTRATIONS
ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION (ECC.) SITE

Compounds	Accepta Subsurface Concentratio (ug/	Water on (1,2) l)	(ug/l)	3,4) Concentration ((ug/kg)	
VOLATILE ORGANICS (VOCs):		•••••	***********	••••	••••
Acetone	3,500	RE		490	
Chlorobenzene	- • -	MCLGP		10,100	
Chloroform	100	MCL	15.7	2,300	
1,1-Dichloroethane	0.38	RB		5.7	
1,1-Dichloroethene	7	MCL	1.85	120	
Ethylbenzene	680	MCLGP	3,280	234,000	
Hethylene Chloride	4.7	RB	15.7	20	
Hethyl Ethyl Ketone	170	LDUNA		75	
Methyl Isobutyl Ketone	1,750	28		8,900	
Tetrachioroethene	0.69	RB	8.85	/ 130	
Toluene	2,000	MCLGP	3,400.	238,000	
1,1,1-Trichloroethane	200	MCL	• 5,280	7,200	
1,1,2-Trichloroethane	0.61	RB	41.8	22	
Trichloroeth ene	5	MCL	80.7	240	
Total Xylenes	440	MCLGP		195,000	
BASE NEUTRAL/ACID ORGANICS:					
Bis(2-ethylhexyl)phthalate	2.5	RS	50,000		
Di-n-Butyl Phthalate	3,500	RB	154,000		
Diethyl Phthalate	28,000	RB	52,100		
I sophorone	8.5	RE			
Naphthalene	14,000	RS	620		
Phenol	1,400	88	570	9,800	
INORGANICS:					
Antimony	14	RB			
Arsenic	50	MCL	0.0175		
Barium	1,000	MCL			
Beryllium	175	RB			
Cadhius	10	MCL			
Chromium VI	50	MCL	11		
Lead	50	MCL	10		
Hanganese	7,000	RB			
Nickel	150	LDVNA	100		
Silver	50	MCL			
Tin	21,000	RB			
Venedium	245	RB			
Zinc	7,000	RS	47		
Cyanide	154	LDWMA	5.2		
PESTICIDES/PCBs:					
PCBs	0.0045	RB (7)	0.000079 (7,8)	

TABLE 3-1 (Page 2 of 2) SITE-SPECIFIC ACCEPTABLE CONCENTRATIONS ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION (ECC SITE)

NOTES:

- (1) RB = Risk-based standard. U.S. EPA, Draft RCRA Facility Investigation Guidance, 1987.
 - MCL = Drinking water Maximum Contaminant Level. 40 CFR 141
 - MCLGP = Drinking water MCL goal, proposed. U. S. EPA Superfund Public Health Evaluation Manual, update of November 16, 1987.
 - LDWHA = Lifetime drinking water health advisory. U.S. EPA, Superfund Public Health Evaluation Manual, update of November 16, 1987.
- In the event that higher concentrations than those set forth for any parameter in this column are present in the upgradient subsurface water in the till and/or sand and gravel according to the procedure specified below, then those higher upgradient subsurface water concentrations and not the values set forth in this table shall constitute the Acceptable Subsurface Water Concentrations within the meaning of this Exhibit A and the Those upgradient subsurface water concentrations Consent Decree. are referred to in this Exhibit A as "Applicable Subsurface Water Background Concentrations." Twelve subsurface water samples will be taken from existing or new well locations, approved by EPA, over at least a 12 month period in areas upgradient of the site. The exact procedure, location of wells, and schedule for collecting and analyzing the samples will be approved by EPA, after consultation with the State, prior to its implementation. Subsurface samples for inorganics and PCB analysis will be filtered. For each parameter, the analytical results from the 12 samples will be analyzed using standard statistical procedures. The mean and standard deviation will be calculated, and all nondetects will be assigned a value equal to 1/2 the EPA-approved quantification limit. For purposes of this Document, "Applicable Subsurface Water Background Concentrations" is defined as two (2) standard deviations above the calculated mean of these 12 samples.
- (3) Stream Criteria, from Table 1 of the Record of Decision for the site, September 25, 1987.
- (4) In the event that higher concentrations than those set forth for any parameter in this column are present in the upstream surface water, then those higher upstream concentrations and not the values set forth in this table shall constitute the Acceptable Stream Concentrations within the meaning of this Exhibit A and the Consent Decree. Those higher upstream surface water concentrations are referred to in this Exhibit A as

"Applicable Surface Water Background Concentrations." Twelve surface water samples will be taken from Unnamed Ditch upstream of the site over at least a 12 month period. The exact procedure, location of samples, and schedule for collecting and analyzing the samples will be approved by EPA, after consultation with the State, prior to its implementation. For each parameter, the analytical results from the 12 samples will be analyzed using standard statistical procedures. The mean and standard deviation will be calculated, and all non-detects will be assigned a value equal to 1/2 the EPA-approved quantification limit. For purposes of this Document, "Applicable Surface Water Background Concentrations" is defined as two (2) standard deviations above the calculated mean of these 12 samples.

- (5) Acceptable Soil Concentration is based on ingestion of subsurface water at the site boundary, assuming a dilution of leachate to subsurface water of 1:196 (Appendix B).
- (6) The Acceptable Soil Concentrations, within the meaning of this Exhibit A and the Consent Decree, will be achieved when the arithmetic average of the 20 soil sample results for each parameter, assigning all non-detect results a value of one-halfethe detection limit, do not exceed the values set forth in this table by more than 25 percent.
- (7) So long as the EPA-approved quantification limit for PCBs in water is above the acceptable subsurface water and stream concentrations for PCBs, compliance with the Acceptable Subsurface and Stream Concentrations for PCBs will be determined as follows: all subsurface and surface water sample results for PCBs must be below the EPA-approved quantification limit for PCBs (at the time compliance is determined).
 - (8) Modified from Superfund Public Health Evaluation Manual, October, 1986, EPA 4/540/1-86/060, OSWER Directive 9285.4-1.

TABLE 1 ENVIRO-CHEM COMPARISON OF EVALUATION CRITERIA

	1987 REMEDY	MODIFIED REMEDY
Protection of human health and the environment	Surface water pro- tected by ground water collection	Surface water pro- tected by soil vapor extraction
Compliance with ARARS	Compliance with off- site ARARs (Accep- table Stream Criteria)	Compliance with off-site ARARs, (Acceptable Stream Criteria), on-site ARARs (Acceptable Soil Concentrations and Acceptable Subsurface Water Concentrations)
Long-term Effectiveness	Less certain, due to slower removal of contaminants, and the need for long-term maintenance of the treatment system	Faster removal of contaminants, and less time required for long-term maintenance
Reduction in Toxicity, Mo- bility and Volume	Slow reduction in volume of contam-inants from ground water collection	Faster reduction in volume of contaminants from soil vapor extraction
Short-term Effectiveness	Little site distur- bance; little chance of releases during construction	Possibility of air and water releases during construction; these will be minimized through engineering controls
Implementability	Simple construction; long-term operation and maintenance re- quired	More complex con- struction; oper- ation and mainte- nance time reduced
Cost	\$3 million	\$5 to \$9 Million
State Acceptance	Full acceptance	Full acceptance
Community Acceptance	Full acceptance	Anticipate ac- ceptance

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EXHIBIT A

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3-3 ·	Chemical Properties of Compounds Detected in the Soils at Concentrations Above the the Acceptable Soil Concentrations	
4-1	Soil Vapor Concentrations in Equilibrium with Acceptable Soil Concentrations	27

EXHIBIT A

2 3 4	
5 6	1.0 INTRODUCTION
7	
8	This document is a Remedial Action Plan (hereafter, "Remedial
9	Action Plan*, "RAP", "Exhibit A" or the "Document") and describes
10	the work to be performed by the Settling Defendants at the
11	Environmental Conservation and Chemical Corporation ("ECC")
12	Superfund site as required by the attached Consent Decree
13	("Consent Decree" or "Decree"). This document is attached as
14	Exhibit A to, and is incorporated by reference into and made an
15	enforceable part of, that Decree.
16	
7	The purpose of this Exhibit A is to set forth those remedial
18	activities to be performed at the ECC site. The Settling
19	Defendants under the Consent Decree ("Settling Defendants") shall
20	arrange to have the work required hereunder performed by a
21	Contractor or Contractors ("Contractor") in accordance with the
22	requirements and specifications set forth herein.
23	
24	The components of the RAP as presented herein are compatible
25	with the proposed remedy for the adjacent Northside Sanitary
26	Landfill (NSL) site. As the remedial design is finalized for the
27	NSL site, the respective RAPs for ECC and NSL will be reviewed to
28	ensure compatibility of design and construction schedules for
29	each system. If any inconsistencies are identified, the Settling
30	Defendants shall consult with those performing the remedy at NSL,
31	and with EPA and the State to attempt to resolve any such
32	inconsistencies.
33	

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35	2.0 REMEDIAL ACTION PLAN
36	
37	2.1 Elements of the RAP
38	
39	2.1.1 Soil Vapor Extraction, Concentration and
40	Destruction
41	
42	The objective of the soil vapor extraction activity is to remove
43	and destroy VOCs and selected base neutral/acid organics from the
44	soils (as provided herein).
45	
46	By systematically and uniformly moving air through the zone of
47	contamination, volatilization and hence removal of organics are
48	accelerated. For the ECC site, air movement through the soil
49	will be controlled by a network of vertical trenches installed
50	throughout the zone of contamination. The process also involves
51	the continuous extraction of organics-laden air from the trench
52	system and treatment of the air by activated carbon to remove the
53	organics. The organics so collected will then be destroyed off-
54	site in conformance with applicable Federal and State
55	requirements.
56	
57	The effectiveness of vapor extraction for organics removal from
58	the ECC soils was demonstrated during a pilot test conducted by
59	Terra Vac, an environmental consulting firm, in June, 1988. The
60	description of the pilot test, including the results obtained,
61	was previously submitted to USEPA and the State of Indiana. The
62	test showed an initial high organics extraction rate of 1.9
63	pounds per day per foot of trench that decreased over the course
54	of the pilot test to a steady state rate of approximately 0.25
55	pounds per day per foot of trench. Although the Terra Vac pilot

66 study provides the foundation for the system designed herein for 67 ECC, during the conceptual and preliminary engineering phase, several engineering and operational enhancements were developed 68 69 which should improve overall performance and effectiveness of the 70 vacuum extraction system to be implemented under this Remedial 71 Action Plan. These system enhancements are the result of consultations among the following environmental consulting firms: 72 73 ERM-North Central, Inc., Midwest Water Resource, Inc. (MWRI), and Terra Vac, Inc. A summary of the key improvements and the 74 75 associated measures employed for this enhanced vapor extraction 76 system are as follows:

77 78

79

80

o Reduction of surface water infiltration within the zone of treatment by construction of the Resource Conservation and Recovery Act (RCRA)-compliant (Subtitle C) cover system;

81 82 83

84 85

86 87 o Reduction in the volume of air required for effective remediation by reducing air infiltration into the vapor extraction system by constructing the RCRA-compliant (Subtitle C) cover;

88

90

91 92 o Reduction of atmospheric discharges of treated extraction air by reinjecting the air through a network of injection trenches installed as part of the vapor extraction system;

94

93

95 o Positive control (collection and removal) of 96 subsurface* till water encountered in the zone of treatment by providing sufficient

98 vacuum and/or supplemental air to remove 99 water which accumulates in the extraction trenches: and 100 101 102 0 Essentially uniform horizontal movement of 103 air through the zone of treatment resulting 104 in enhanced contact between the air and the 105 VOCs in the soil during operation of the soil vapor extraction system by utilizing a 106 network of injection and extraction trenches 107 108 in conjunction with the impervious cover provided by the RCRA-compliant (Subtitle C) 109 110 cover system. 111 112 * For purposes of this document, "subsurface" water shall mean 113 "ground water", as defined at 40 CFR 260.10. 114 115 The following discussion and drawings show concepts and details 116 of the design and operation of the soil vapor extraction system. 117 118 The soil vapor extraction process is illustrated in Figures 2-1 119 and 2-2. The basic operation consists of extraction of air using 120 a single vacuum pump from a network of 28 extraction trenches 121 located throughout the site. Free liquid entrained in the air is 122 removed by gravity in an entrainment separator. Periodically, 123 water which accumulates in the entrainment separator is pumped to 124 an on-site storage tank for subsequent transport to an off-site 125 facility for treatment as necessary, in accordance with 126 applicable Federal, State and local regulations. From the vacuum 127 pump, air passes through the carbon adsorption system, which

consists of two upflow carbon columns connected in series. Off-

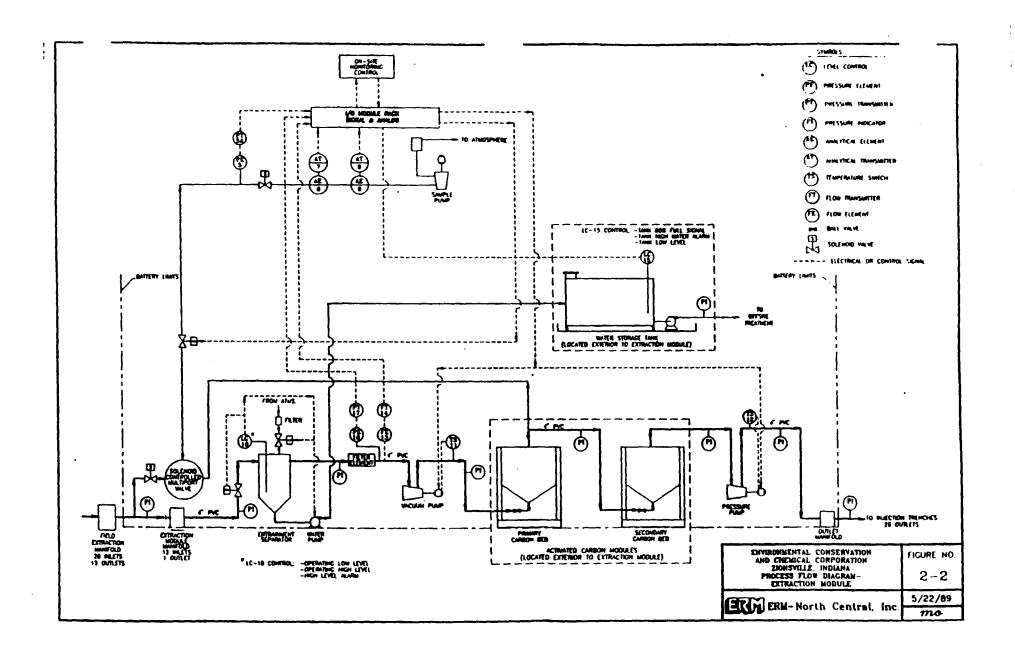
gases from the carbon adsorption system are withdrawn by a pump

128

29

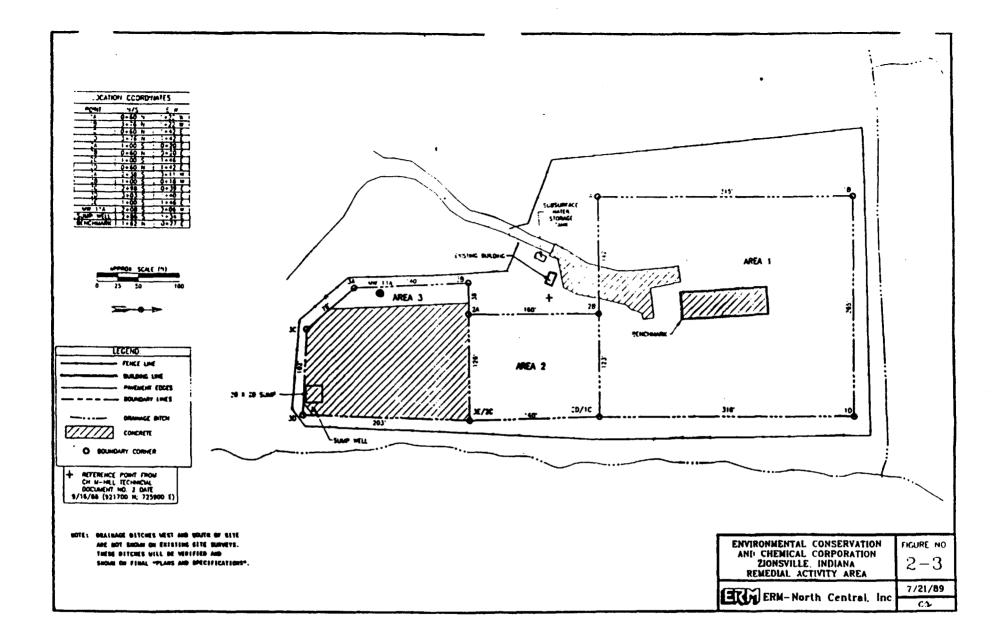
OTRACTION TRENCH (TIPICAL FOR 28) TO COLLECTION OF THE PARTY OF T TRENCH BOTTOM - EMD OF TREMON EXTRACTION TRENCH
(26 MLTTS) FIELD EXTRACTION (12 ONILETS) P) Dob - PRESSURE NOTICATOR WITH DAPPRAGU SAN, & SHUTOTT COCK PAIN CATE VALVE BALL NAVE (FULLY PORTED) TO MUTCH TO BUILDING TO PACE ERM-North Central, Inc. THENCH BOTTOM END OF THENCH ENTRONMENTAL CONSERVATION
AND CHEMICAL CORPORATION
ZIONSYLLE, INDIANA
PROCESS FLOT AND
INSTRUMENT DIACRAN DEADMAN FRENCH HUICHON THENCH (THENCH FOR 26) FIGURE NO 2-1 6/23/89 S

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130 which boosts the pressure and reinjects air into a network of 26
131
     injection trenches located throughout the site. Each injection
132
     trench is located between and parallel to a pair of extraction
133
                The injected air then migrates from the injection
134
     trench through the soil towards the extraction trench. As the
     air migrates through the soil towards the extraction trench, the
135
136
     organics are vaporized into the air stream. As described in
137
     Section 2.1.2, the RCRA-compliant (Subtitle C) cover will be
     placed over the entire trench network to prevent air and water
138
139
     infiltration into the system during operation.
140
141
     The major system components are:
142
143
               Extraction and injection trenches;
144
145
               Soil vapor extraction system;
146
147
               Water collection system;
          0
148
149
               Carbon adsorption system;
150
151
               Air injection system; and
          0
152
153
               RCRA-compliant (Subtitle C) cover.
          0
154
    A description of the design and operational features of each of
156
    these components is presented below.
157
158
          Extraction and Injection Trenches
159
160 The area where remedial activity will occur is depicted in Figure
          The west boundary of Area 1 encompasses the area of ECC
 .1
```



....

```
as verified by an examination of aerial photographs, and
163
164
     coincides with a pre-existing earthen berm which formed the
     western boundary of ECC's water containment system for this area.
165
166
167
     The layout and construction details for the network of 28
     extraction trenches and 26 injection trenches are presented in
168
169
     Figures 2-4 and 2-5. Trench spacing will be 18 feet, and trench
170
     length varies depending on the configuration of the site.
171
     Construction details of extraction trenches and injection
172
     trenches are identical. By implementing minor above-ground
173
     piping changes, injection trenches can and will be utilized as
     extraction trenches. The work required under this Remedial
174
75
     Action Plan will initially involve using the original extraction
176
    trenches for extraction; at some point in the process, the
177
     extraction trenches will be converted to injection trenches, and
178
     vice versa, to ensure complete vapor extraction of the soil.
179
180
     All trenches are to be a minimum of 9-feet deep as measured from
181
     existing grade, and will be backfilled with washed "float" stone.
     The trench width will be 12-15 inches. The bottom elevation for
182
     both injection and extraction trenches will be sloped at a
183
    minimum of 1/16-inch per foot to a low point located at the water
184
185
     collection pipe as noted in Section A-A of Figure 2-5.
186
    Soil removed from the trench excavation will be spread over the
187
    surface of the facility prior to construction of the cover system
188
189
    and covered in accordance with the final RCRA-compliant (Subtitle
    C) cover detail illustrated in Figure 2-5. Soil removed from the
190
191 trenches constructed in the areas of the concrete pad (Area 3)
```

activities that resulted in hazardous substances being released,

162

--- will be spread over the surface in Areas 1 and 2 with trench

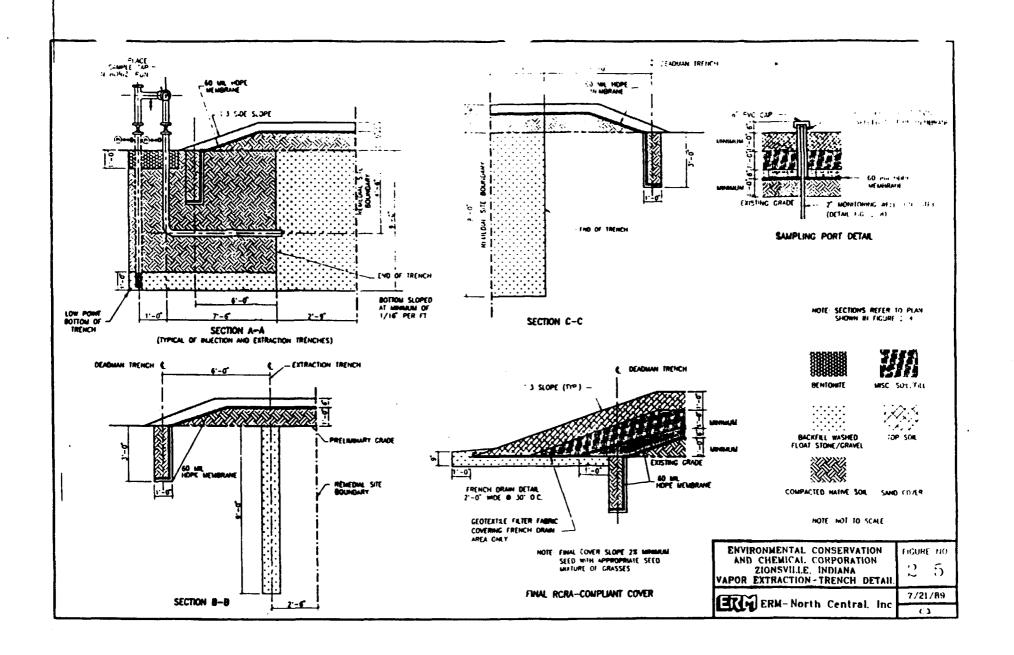
spoils from those areas.

;

194 195 Each trench will be equipped at one end with a vapor extraction pipe and a water collection pipe as illustrated in Section A-A of 196 Figure 2-5. Both pipes will be 4-inch diameter, Schedule 40 PVC. 197 198 Each pipe segment will be equipped with pressure/vacuum indicator, isolating valve and sample tap. 199 A "T" at the top of the water collection pipe will permit the future installation of 200 201 air piping to air lift water from the trench network, if 202 necessary. Individual 4-inch, Schedule 40 PVC pipes will be routed from each extraction trench to the extraction module. 203 The 204 extraction module will be located adjacent to the existing concrete pad near the site entrance. Alternatively, two or three 205 206 extraction trenches will be manifolded together and conveyed to ! the extraction module via a 4-inch, Schedule 40 PVC pipe. 07 Injection trench piping is identical to the extraction trench 208 209 piping and, as previously described, will permit it to be utilized as an extraction trench during the operation of the 210 vapor extraction system. To minimize field piping from the 211 extraction module to the injection trenches, 4 to 8 injection 212 trenches will be manifolded together. Four-inch, Schedule 40 PVC 213 214 pipe will be used to convey air returned from the extraction module to the injection trench. 215 216 217 The Sump Well installed by EPA will be backfilled with the material used to backfill trenches (i.e, float stone) and a 4-218 inch PVC pipe will be installed between the Sump Well and the 219 nearest extraction trench, thereby tying the Sump Well directly 220 into the vapor extraction system. The existing 20 ft. x 20 ft. 221 222 sump will be handled similarly, and will be dewatered prior to 223 installing the RCRA-compliant (Subtitle C) cover system. All water removed from this sump will be handled in accordance with 724

applicable Federal, State and local requirements.

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....

226 227 Soil Vapor Extraction System 228 229 The vacuum pump will have a nominal capacity of 500 standard 230 cubic feet per minute (SCFM) and will be capable of developing a 231 vacuum of 18 inches Hg. The normal operating vacuum is 232 anticipated to be 12 inches Hg. Based on MWRI's experience with soils characteristic of the ECC site and on the Terra Vac pilot 233 234 study results at the ECC site, the zone of influence at the operating vacuum will be at least 40 feet (20 feet either side of 236 the trench). The pilot test results showed an initial radius of influence of 15 feet during trench development. Under continuous? 237 operation, the radius of influence increased to about 20 feet. 238 `39 The enhanced operating efficiency obtained by installing an impervious cover and injecting air will increase the radius of 241 influence to over 20 feet. To be conservative, a spacing between 242 trenches of 18 feet was selected. 243 244 The vacuum will be applied at the trench outlet and will be 245 distributed throughout the entire length and vertical dimension 246 of the trench. The highly porous backfill material used will assure this uniform distribution of vacuum throughout the 247 248 extraction trench. The reinjection pressure of air in each adjacent injection trench will be approximately 37.4 inches Hg 249 (1.25 atm). Therefore, the pressure differential and driving 250 force for air movement between injection and extraction trenches 251 under normal operating conditions is approximately 19.4 inches Hg 252 253 (0.65 atm). 254 255 The selection of the design air volume of 500 SCFM is based upon

plant test results. The criteria established is to provide at

256 MWRI's experience and is consistent with the Terre Vac pilot

least one air volume change per soil pore volume per day. Based 258 259 upon an area of treatment of 150,000 square feet, a depth of 260 contamination of 9 feet, and a soil porosity of 10%, 500 SCFM 261 exceeds the MWRI criteria by 400%. 262 263 The vapor extraction process will operate continuously and will 264 shut down automatically only in the event of an operating problem or malfunction. The following are conditions which will shut 265 down normal operating sequence of the vapor extraction system: 266 267 268 High vapor temperatures above the estimated acceptable range of 150 to 180°F prior to 269 270 activated carbon treatment; `1 12 Low vapor temperatures below the estimated 0 273 acceptable range of 75 to 85°F prior to 274 activated carbon treatment indicating 275 relative humidity above the estimated 276 acceptable range; 277 278 High water level in water entrainment 0 279 separator indicating operating problems with 280 liquid transfer operation; 281 282 High water level in subsurface water storage 0 283 tank: 284 285 High or low pressure conditions on vacuum or 0 286 injection pumps under normal operating 287 conditions; and 208

Power interruptions for the site.

0

290

During normal operation, vapor extraction will be stopped to facilitate carbon vessel change out as described later in this section and during transfer of water from the entrainment separator to the on-site subsurface water storage tank, or to conduct restart spike tests.

296

297 The air extracted from the system will be continuously monitored 298 by in-line instrumentation as shown on the process flow diagram (Figure 2-2) and described on Table 2-1 (Instrument Summary 299 300 Sheet). The capability will exist to sample individual trench 301 exhausts or the combined air stream. Sample taps will be 302 provided to collect vapor samples for detailed chemical analysis. 03 The on-line instrumentation will consist of a photoionization 304 detector (PID) and moisture analyzer. The vacuum pump, controls 305 and instrumentation will be located in the Vapor Extraction 306 Module Building.

307 308

Water Collection System

309

The high vacuum vapor extraction system selected will be capable 310 of entrainment and movement of water which accumulates in the 311 312 extraction trenches. Any free liquid in the extracted vapor will 313 be separated by gravity in an entrainment separator located in 314 the Vapor Extraction Module Building. A level control system 315 will be utilized to control the removal of water which 316 accumulates in the entrainment separator as required. 317 separator tank is equipped with a vacuum breaker system which 318 will open the tank to the atmosphere to permit water to be transferred by pump from the separator to an on-site water 319 storage tank as necessary. The time required to make this 50 21 transfer will depend upon the equipment supplied by the vapor

TABLE 2-1 ERM-NORTH CENTRAL, INC. INSTRUMENT SUMMARY SHEET

CLIENT: Environmental Conservation and Chemical Corporation

المراجع والمراجعة المستبينية فيخييه ويتويرها والمرازي

PROJECT NO.: 9041

PT-17 Pressure transmitter

DATE:	2/28/89 REVISED: 5/23/89	ROOT	RENCES
TAG NO.	SPRVICE	MOUNTING PANEL FIELD	SPEC FLOW
PI	Pressure Indicator	x	2-1 2-2
PI-1	Pressure Indicator	(
thru	with diaphram	` } x	2-1
PI-4	Seal and shutoff cock	(
PE-5	Pressure sensing element		:
PT-5A	Pressure transmitter	x	2-2
AE-6	Moisture sensing element	x	2-2
AT- 7	Moisture transmitter	x	2-2
AE-8	Volatile organics detector and quantifier	x	2-2
AT-9	Volatile organics quantified signal transmitter	x	2-2
LC-10	3-point water level control and alarm	x	2-2
TS-11	Gas temperature sensor with high level system shutdown switch	x	2-2
TS-12	Gas temperature sensor with high level system shutdown switch	x	2-2
FE-13	Gas flow measuring element	x	2-2
FT-14	Gas flow signal transmitter	x	2-2
IC-15	3-point water level control and alarm	x	2-2
PE-16	Pressure sensing element	x	2-2

X

2-2

322 extraction system vendor selected.

323

324 The size of the storage tank will be sufficient to store the liquids, considering the off-site handling/treatment option 325 326 selected. If water collected from the soil vapor extraction 327 system is to be discharged to the Northside Sanitary Landfill (NSL) pipeline, a 1,000-gallon storage tank will be used; or if 328 329 water collected is to be hauled off-site by tank truck for disposal, a 10,000-gallon tank will be used. The tank will be 330 equipped with level measurement and control to advise operating 331 personnel to the status of liquid accumulation in the storage 332 333 tank. Periodically, the contents of the water storage tank will 334 need to be removed. The removed water will either be sent to the 5 Indianapolis POTW via the NSL pipeline or truck, or to another 336 off-site facility for handling and treatment as necessary, in 337 accordance with applicable Federal, State and local regulations.

338

339

340

Carbon Adsorption System

341

342 From the water entrainment tank, the air passes through a particulate filter preceding the vacuum pump. The pressure drop 343 344 across the filter will be monitored and used as the signal for determining servicing of the filter element. The exhaust from 345 the vacuum pump will be piped directly to a two-stage carbon 346 347 adsorption system (primary and secondary). This system will 348 consist of two vessels in series each containing approximately 1,800 pounds of granular activated carbon. The organics 349 350 contained in the extracted air will be adsorbed on the activated The moisture content of the air stream will be less 351 carbon. than 50% relative humidity and temperatures will be approximately 150°F, both acceptable for efficient operation of carbon

355 356 During the initial phases of operation, when organics 357 concentrations in the air stream will be highest, the carbon 358 capacity for the organics is expected to be about 25% by weight. 359 During the latter phases of remediation as organic concentration 360 of vapor decreases, the projected carbon capacity for organics will range between 10-15% by weight. Based upon an assumed total 361 362 mass of organics of about 5,000 pounds (Appendix A), the total 363 quantity of activated carbon required for the entire remediation 364 program is 25,000 pounds. This equates to fourteen 1800-pound 365 carbon vessels for the entire program. The actual amount of 366 carbon used will depend upon the total mass of organics extracted 67 during operation of the soil vapor extraction system and the carbon adsorption capacity. 368 369 370 The vapor from the primary carbon vessel will be monitored 371 frequently (approximately once per hour) by an on-line PID 372 analyzer. When the PID analyzer detects organic vapor in the air 373 stream between the primary and secondary carbon vessels, the 374 vacuum extraction system will shut down automatically to permit the removal and replacement of the "spent" primary carbon vessel. 375 An operator will be alerted to this condition, and will 376 377 disconnect the primary carbon bed from service. The spent carbon 378 vessel will be removed and replaced by a carbon vessel containing 379 fresh activated carbon. The unit previously serving as the 380 secondary carbon bed will become the primary carbon bed and the 381 unit just placed in operation will be the secondary carbon bed. Once this switch is complete, the soil vapor extraction system 382 (i.e., vacuum pump and injection pump) will be restarted, and the 383 system operation resumed. The arrangement of two activated

carbon vessels in series (i.e., primary and secondary) will

354

J5

adsorption.

386 permit optimal utilization of the activated carbon, and efficient 387 capture of the organics.

388

389 The spent carbon vessels will be stored on-site. The vessels will be stored on the existing concrete pad adjacent to the vapor 390 391 extraction module building, inside the fenced area. An 392 approximate location of this area is shown in Figure 2-4. 393 inlet and outlet connections to each vessel will be capped and 394 sealed appropriately. Periodically when a truckload quantity of vessels has accumulated, and at the conclusion of the vacuum 395 396 extraction program, the vessels containing the spent carbon will 397 be transported in accordance with applicable Federal, State and ? local requirements to an off-site facility where the carbon will 398 ٦99 be regenerated by high temperature incineration, and in the .00 process, the organics adsorbed on the carbon will be destroyed.

401 402

Air Injection System

403

404 The exhaust air from the secondary carbon bed will be piped to 405 the injection pump located in the extraction module building. 406 The injection pump will be capable of delivering 500 SCFM at 10 407 psig (1.65 atm). The discharge from the injection pump will be 408 distributed to the 26 injection trenches via a system of 409 manifolds. Control of the injection pump will be interlocked 410 with the vacuum extraction pump. The pipe at each injection 411 trench will be equipped with a pressure/vacuum gauge so that 412 injection pressure at the trench can be periodically monitored.

- 414 During the soil vapor extraction program, the injection trenches
- 415 will be utilized as extraction trenches and vice versa. This car
- 416 be accomplished by minor above ground manifold piping
 - 7 modifications. It is also planned that as the Cleanup Standards

set forth in Table 3-1 below are met for individual trench 419 "areas", the corresponding extraction and injection trenches will 420 be isolated from the extraction and injection operation by 421 closing the shut off valves located at each trench. 422 permit the soil vapor extraction system to concentrate on any 423 remaining areas which have not fully achieved the Cleanup 424 Standards specified in Table 3-1, thereby accelerating cleanup of 425 those areas. 426 427 RCRA-Compliant (Subtitle C) Cover 428 The operation of the vapor extraction system will be enhanced by 429 the installation of the RCRA-compliant (Subtitle C) cover over 430 `31 the entire site. Details and a schedule for installation of the final RCRA-compliant (Subtitle C) cover are presented in Section 432 433 2.1.2. 434 435 Miscellaneous 436 437 Each extraction trench is equipped with two 0 438 sample taps, one on the vacuum pipe and one on the water collection pipe. Each of these 439 taps can be fitted with a sample bottle for 440 the collection of free moisture. 441 442 443 Electrical service required for the site 0 444 remediation work is anticipated to be 3-445 phase 460 volt. Total electrical demand will be approximately 100 KVA. Power distribution 446 will be to the extraction module building. 447 448 Operating voltage for the extraction and

injection pumps is anticipated to be 460

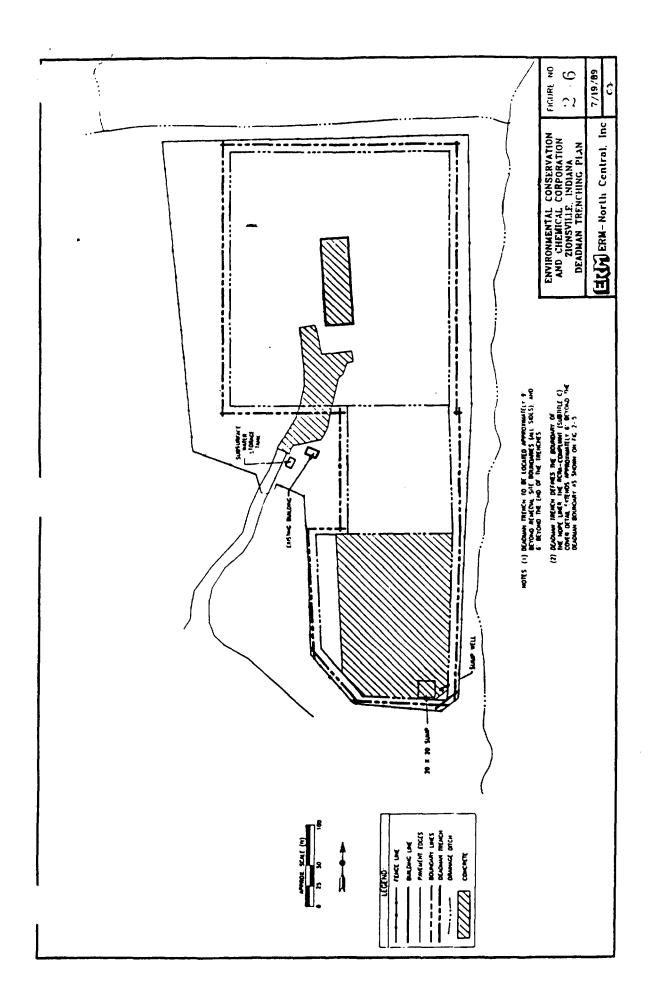
450	volts. A 110 volt supply will be provided
451	for miscellaneous site lighting, equipment,
452	instrumentation and controls. Power
453	distribution to any site construction and
454	office trailers will also be provided.
455	
456	o Prior to construction of the trenches, the
457	following activities will be conducted:
458	
459	 The existing buildings within the
460	area currently fenced will be
461	demolished and properly disposed of
462	off-site;
463	
464	The existing tanks removed and
465	properly disposed of off-site; and
466	
467	3. The site will be graded to fill
468	existing depressions and to
469	eliminate any sharp grade changes.
470	
471	2.1.2 RCRA-Compliant (Subtitle C) Cover
472	
473	The RCRA-compliant (Subtitle C) cover illustrated in Figure 2-5
474	will consist of a minimum of 1-foot of compacted, highly
475	impermeable native soil, a continuous welded 60 millimeter high
476	density polyethylene (HDPE) plastic membrane, a minimum 6-inch
477	layer of compacted sand for drainage, 1 to 3 feet of
478	miscellaneous soil/fill material and 1 foot of top soil to
479	support vegetation. The final grading plan will ensure a minimu
180	slope of 2%. The native soil used will be the silty clay till
81	available in the area, which can and will be compacted by

482 standard methods to 95% proctor density. If soil from the neighboring NSL Facility borrow area is not available, material 483 484 with similar performance will be obtained by Settling Defendants 485 from another source. 486 487 To provide a perimeter seal of the HDPE membrane, a 1-foot wide, 3-foot deep "deadman trench" will be installed around the site 488 boundary (Figure 2-6). The HDPE membrane will be draped into 489 The trench will then be backfilled and compacted 490 491 with native soil (silty clay till) to 95% proctor density. cover will extend approximately 6 feet beyond the deadman trench 492 493 as noted on Figure 2-6 and detailed on Figure 2-5. 494 495 As previously described, the material excavated from the trenches 496 will be graded uniformly throughout trench areas 1 and 2 and incorporated into the top layer of existing surface soil prior to 497 the construction of the RCRA-compliant (Subtitle C) cover as 498 499 shown in Figure 2-5. 500

The RCRA-compliant (Subtitle C) cover will be installed over the 501 entire site, including the concrete pad. Prior to operation of 502 the soil vapor extraction system, the following components of the 503 504 RCRA-compliant (Subtitle C) cover will be installed: minimum compacted native soil; (2) a 60 mil HDPE membrane; and 505 (3) 6 inches of sand. Prior to installation of the remaining 506 507 components of the cap, Settling Defendants shall ensure that the 508 aforesaid components of the cap meet the aforesaid specifications. The remaining components (1-foot minimum 509 miscellaneous soil/fill, 1-foot minimum topsoil and appropriate 510 vegetation) will then be installed in accordance with the 511 schedule presented in Section 5.0. At completion of the soil 512

13ز

vapor extraction program all surface piping will be removed from



.

515 that time the extraction and injection trench piping may be cut off at the current grade, filled with grout, and covered with a 516 minimum of 1 foot of topsoil, which will be vegetated. 517 518 Vegetation which will be established shall include fibrous, 519 shallow, laterally growing roots, such as grass (which may include red fescue and Kentucky blue grass). 520 521 522 The Settling Defendants shall conduct periodic inspections and shall repair the cap as necessary to ensure its integrity in 523 accordance with the time periods set forth in 40 CFR Sections 524 265.117 and .118 or 329 I.A.C. Sections 3-21-8 and -9. 525 526 27 2.1.3 Access Restrictions 28د 529 Access restrictions to be implemented by the Settling Defendants 530 will consist of a fence around the site perimeter and the posting 531 of warning signs. In addition, Settling Defendants will use 532 "best efforts", as that term is used in Section X A. of the Decree, to have recorded appropriate restrictions with the County 533 534 Recorder's Office prohibiting: (a) usage of the site for excavation and development; (b) usage of ground water from the 535 saturated till and the underlying sand and gravel; and (c) 536 537 installation of new water wells other than monitoring wells. 538 539 2.1.4 Subsurface and Surface Water Monitoring 540 541 542 The monitoring activities will: 543 - 4 Detect the presence of the VOCs, base

the site in addition to any equipment, buildings or trailers. At

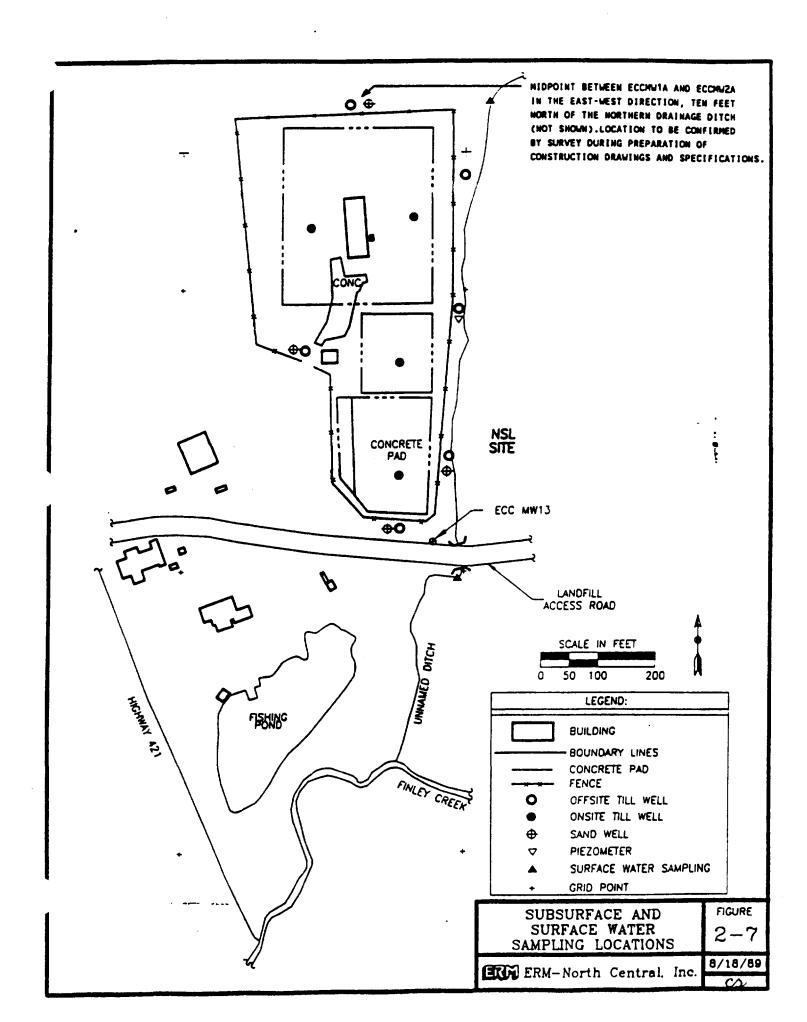
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neutral/acid organics, PCBs, and heavy metals

546 specified in Table 3-1 in the subsurface and 547 surface water during and after vapor 548 extraction; and 549 550 Provide information to determine the 0 effectiveness of the soil vapor extraction 551 552 program. 553 Two types of subsurface water monitoring systems will be 554 installed under this Remedial Action Plan. The first is an on-555 site till monitoring system consisting of four wells screened in 556 557 the saturated zone of the till. The location of these on-site 58 till wells is shown in Figure 2-7. Sampling results from the onsite till wells will be compared to the Acceptable Subsurface 560 Water Concentrations in Table 3-1 or the Applicable Subsurface 561 Water Background Concentrations of Table 3-1 ("Applicable 562 Subsurface Water Background Concentrations"). 563 564 Samples from the on-site till monitoring wells will be collected at the beginning of the soil vapor extraction operation and 565 566 quarterly thereafter until completion of the soil vapor extraction program. Monitoring will be continued on a semi-567 annual basis as specified in Section 4.0. Every time samples are 568 collected from the on-site wells, the soil vapor extraction 569 system will be shut down to allow water, if any, to stabilize 570 571 within the till. Samples collected from the on-site wells will 572 be analyzed for those parameters listed under Acceptable Subsurface Water Concentrations in Table 3-1. 573 574

The second type of subsurface water monitoring system consists of off-site wells screened in the till and offsite wells screened in

575



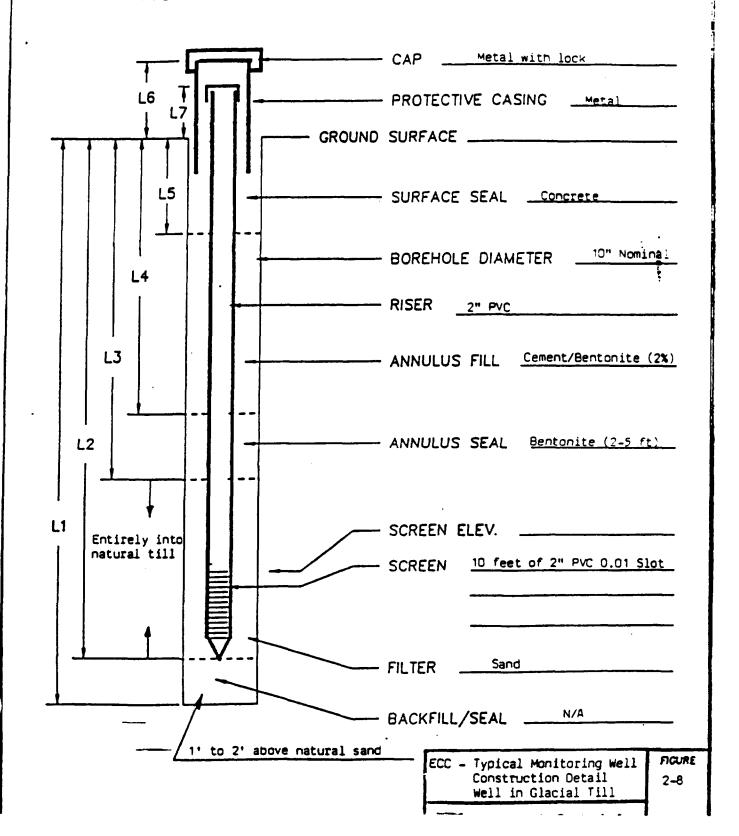
578 the sand and gravel. Sampling results from these wells will be used to determine compliance with the Acceptable Stream 579 Concentrations in Table 3-1 or the Applicable Surface Water 580 581 Background Concentrations of Table 3-1. This second subsurface water monitoring network will consist of ten (10) new wells, 582 583 which will be located around the periphery of and downgradient from the ECC site, and one existing monitoring well, ECC MW-13 584 (Figure 2-7). In addition, a piezometer will be installed on the 585 east side of the site, as shown in Figure 2-7, to aid in defining 586 the direction of subsurface water flow in the sand and gravel. 587 Six (6) wells will be installed in the till, completed in the 588 589 saturated zone, and four (4) wells will be completed in the sand? and gravel unit underlying the saturated surface till. 590

91

92د All wells (on-site and off-site) will be constructed of 2-inch PVC pipe. Screen length will vary for each well. Total depth 593 594 for the wells completed in the till will be 1-2 feet less than total depth to the contact between the till and underlying sand 595 and gravel. Wells completed in the sand and gravel will screen 596 597 the total thickness of that sand and gravel unit. Screens will have a 0.01 inch opening. Wells will have a sand pack to one 598 599 foot above the top of screen and a bentonite grout to the ground 600 surface. For the on-site till wells, a sampling port will be fabricated in the HDPE membrane which will prevent infiltration 601 of air via these monitoring wells during operation of the soil 602 603 vapor extraction system. A detail of this sampling port is shown on Figure 2-5. Figures 2-8 and 2-9 illustrate well construction 604 details for the subsurface water monitoring wells in the till and 605 in the sand and gravel, respectively. Details of the piezometer 606 607 construction are shown in Figure 2-10. The location of the 178 monitoring wells is based on the subsurface water elevation 9 contours shown in Figure 2-11.

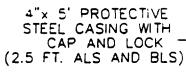
-19-

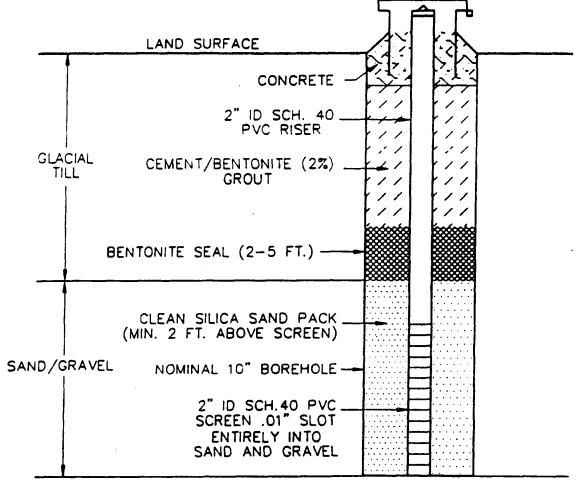
MONITORING WELL CONSTRUCTION



MONITORING WELL CONSTRUCTION - CAP Metal with lock L6 - PROTECTIVE CASING _____Metal_ - GROUND SURFACE _____ **L5** - SURFACE SEAL ___Concrete BOREHOLE DIAMETER 10" Nominal - RISER 2" PVC L3 - ANNULUS FILL Cement/Bentonite (2%) - ANNULUS SEAL Bentonite (2-5 ft) In upper tills L2 L1 Entirely into SCREEN ELEV. _ natural sands 2" PVC 0.01 Slot SCREEN (Entire depth of sand and gravel Sand - FILTER BACKFILL/SEAL . ECC - Typical Monitoring Well FIGURE

Construction Detail Well in Sand & Gravel



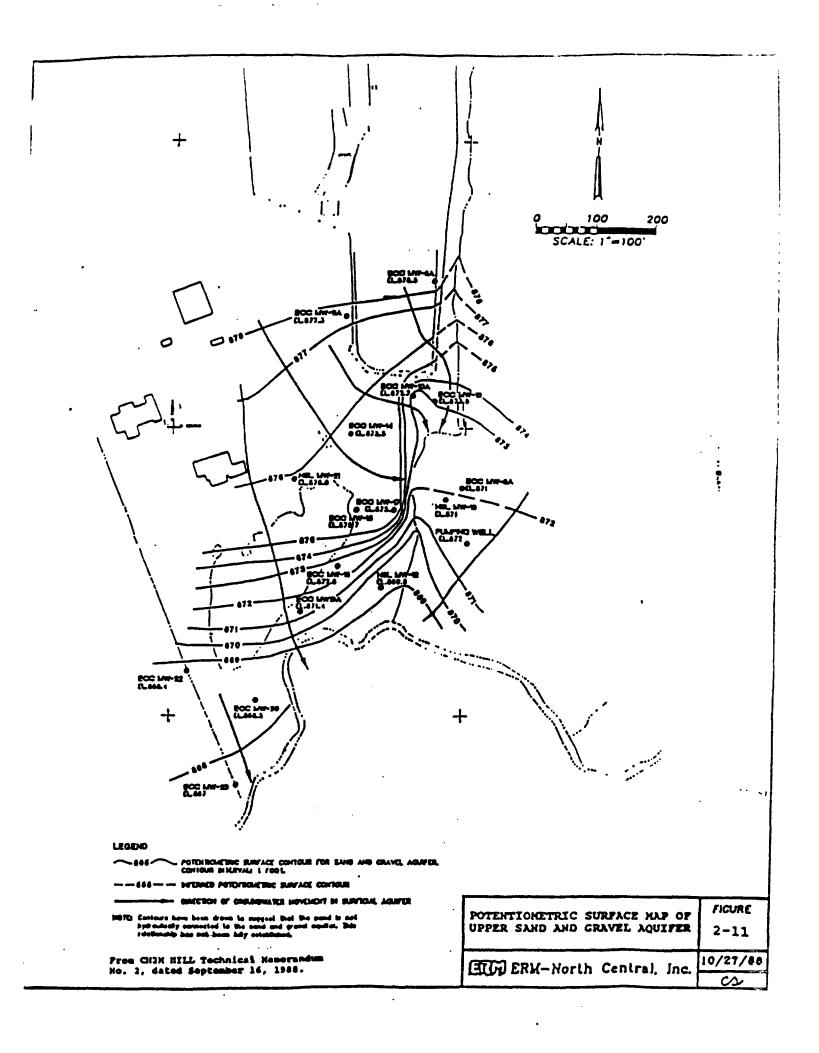


GLACIAL TILL

NOT TO SCALE

ECC-TYPICAL PIEZOMETER
CONSTRUCTION DETAIL
INSTALLED IN SAND AND GRAVEL

| Solution | So



Samples from the off-site wells will be collected quarterly 611 during operation of the vapor extraction system and analyzed for 612 613 the parameters with Acceptable Stream Concentrations in Table 3-Monitoring will be continued on a semi-annual basis as 614 615 specified in Section 4.0. 616 617 The surface water will be monitored by sampling the Unnamed Ditch just upgradient and just downgradient of the ECC site as depicted 618 619 in Figure 2-7. Surface water will be sampled at the same frequency as the off-site subsurface water and analyzed for the. 620 parameters with Acceptable Stream Concentrations in Table 3-1. 621 622 623 624 3.0 REMEDIAL ACTION CLEANUP STANDARDS 625 626 This section presents site-specific Cleanup Standards to be used 627 at the ECC site as the criteria for determining completion of remedial action. The Cleanup Standards in this section are the 628 basis for establishing the criteria for Soil Cleanup 629 Verification presented in Section 4.2, and the Post-Soil Cleanup 630 631 Verification Compliance Monitoring in Section 4.3. Cleanup Verification as defined in Section 4.2 and the 632 subsections thereof is not achieved within 5 years of commencing 633 634 operation of the soil vapor extraction system, the Additional Work provisions of Section VII of the Consent Decree will apply. 635 636 637 638 639 640 3.1 Cleanup Standards

610

642	The Iolic	owing Cleanup Standards will be met for successful
643	completion	on of the soil vapor extraction program:
64,4		
645	•	Acceptable Soil Concentrations shown in Table
646		3-1 will be achieved according to the
647		procedure discussed in Section 4.2.3 of
648		Exhibit A;
649		
650	0	Acceptable Stream Concentrations or
651		Applicable Surface Water Background
652		Concentrations shown in Table 3-1 will be
653		achieved in Unnamed Ditch south of and
654		adjacent to ECC;
555		
656	. 0	Acceptable Subsurface Water Concentrations
657		or Applicable Subsurface Water Background
658		Concentrations shown in Table 3-1) in the
659		on-site till wells will be achieved; and
660		
661	0	Acceptable Stream Concentrations or
562		Applicable Surface Water Background
563		Concentrations shown in Table 3-1 in the
564		off-site wells will be achieved.
565		
566	The term	"Table 3-1" wherever referred to or used in this Exhibit
567	A and in	the Consent Decree includes the Footnotes on pages 2 and
568	3 of 3 of	that table.
69		
570		
571	3.2	Calculation of Cleanup Standards
572		
73	Table 3-1	sets forth the ECC site specific Cleanup Standards and

TABLE 3-1 (Page 1 of 2)
SITE-SPECIFIC ACCEPTABLE CONCENTRATIONS
ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION (ECC.) SITE

	Acceptable			
	Subsurface	Water	Acceptable Stream	Acceptable Soil
	Concentration (1,2) (ug/l)		·	Concentration (5,6)
Compounds			(ug/l)	(ug/kg)
MONATURE ORGANICE (MOCA).	*********	• • • • • • • •	••••••	
VOLATILE ORGANICS (VOCs):	3,500			490
Acetone	3,300 60			•••
Chi orobenzene		NCL	15.7	10,100
Chloroform	0.38		13.7	2,300 5.7
1,1-Dichloroethane		MCL	1.85	120
1,1-Dichloroethene		MCLGP	3,280	
Ethylbenzene	4.7		15.7	234,000 20
Methylene Chloride	170	_	13.7	75
Methyl Ethyl Ketone				· -
Methyl Isobutyl Ketone	1,750 0.69		8.85	8,900 130
Tetrachioroethene Toluene				238,000
1,1,1-Trichtoroethane	2,000	MCLGP MCL	3,400 5,280	7,200
1,1,2-Trichloroethane	0.61		41.8	22
Trichloroethene	5		80.7	240
Total Xylenes	440	MCLGP		195,000
BASE NEUTRAL/ACID ORGANICS:	440	110201		177,000
Sis(2-ethylhexyl)phthalate	2.5		50,000	
Di-n-Butyl Phthalate	3,500		154,000	
Diethyl Phthalate	28,000		52,100	
Isophorone	8.5		22,100	
Naphthalene	14,000		620	
Phenol	1,400		570	9,800
INORGANICS:	.,,,,,,		5. 0	7,000
Antimony	14	RS		
Arsenic		HCL	0.0175	
Sarius	1,000			
Beryllium	175			
Cadnium		MCL		
Chronium VI		HCL	11	
Lead	50	MCL	10	
Hanganese	7,000	RB		
Nickel	150	LDUKA	100	
Silver	50	MCL		
Tin	21,000	RB		
Vanadium	245	RB		
Zinc	7,000		47	
Cyanide	154	LDWNA	5.2	
PESTICIDES/PCBs:	_			
PCBs	0.0045	RB (7)	0.000079 (7,8)	

TABLE 3-1 (Page 2 of 2) SITE-SPECIFIC ACCEPTABLE CONCENTRATIONS ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION (ECC SITE)

NOTES:

- (1) RB = Risk-based standard. U.S. EPA, Draft RCRA Facility Investigation Guidance, 1987.
 - MCL = Drinking water Maximum Contaminant Level. 40 CFR
 141
 - MCLGP = Drinking water MCL goal, proposed. U. S. EPA Superfund Public Health Evaluation Manual, update of November 16, 1987.
 - LDWHA = Lifetime drinking water health advisory. U.S. EPA, Superfund Public Health Evaluation Manual, update of November 16, 1987.
- In the event that higher concentrations than those set forth for any parameter in this column are present in the upgradient ... subsurface water in the till and/or sand and gravel according to the procedure specified below, then those higher upgradient subsurface water concentrations and not the values set forth in this table shall constitute the Acceptable Subsurface Water Concentrations within the meaning of this Exhibit A and the Those upgradient subsurface water concentrations Consent Decree. are referred to in this Exhibit A as "Applicable Subsurface Water Background Concentrations. " Twelve subsurface water samples will be taken from existing or new well locations, approved by EPA, over at least a 12 month period in areas upgradient of the site. The exact procedure, location of wells, and schedule for collecting and analyzing the samples will be approved by EPA, after consultation with the State, prior to its implementation. Subsurface samples for inorganics and PCB analysis will be filtered. For each parameter, the analytical results from the 12 samples will be analyzed using standard statistical procedures. The mean and standard deviation will be calculated, and all nondetects will be assigned a value equal to 1/2 the EPA-approved quantification limit. For purposes of this Document, "Applicable Subsurface Water Background Concentrations" is defined as two (2) standard deviations above the calculated mean of these 12 samples.
- (3) Stream Criteria, from Table 1 of the Record of Decision for the site, September 25, 1987.
- (4) In the event that higher concentrations than those set forth for any parameter in this column are present in the upstream surface water, then those higher upstream concentrations and not the values set forth in this table shall constitute the Acceptable Stream Concentrations within the meaning of this Exhibit A and the Consent Decree. Those higher upstream surface water concentrations are referred to in this Exhibit A as

"Applicable Surface Water Background Concentrations." Twelve surface water samples will be taken from Unnamed Ditch upstream of the site over at least a 12 month period. The exact procedure, location of samples, and schedule for collecting and analyzing the samples will be approved by EPA, after consultation with the State, prior to its implementation. For each parameter, the analytical results from the 12 samples will be analyzed using standard statistical procedures. The mean and standard deviation will be calculated, and all non-detects will be assigned a value equal to 1/2 the EPA-approved quantification limit. For purposes of this Document, "Applicable Surface Water Background Concentrations" is defined as two (2) standard deviations above the calculated mean of these 12 samples.

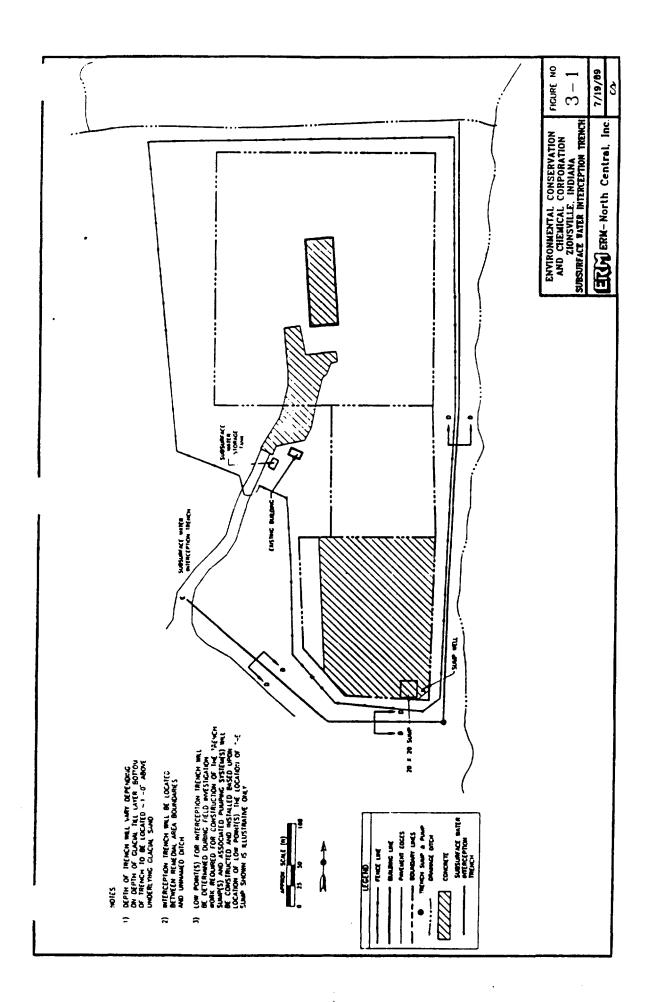
- (5) Acceptable Soil Concentration is based on ingestion of subsurface water at the site boundary, assuming a dilution of leachate to subsurface water of 1:196 (Appendix B).
- (6) The Acceptable Soil Concentrations, within the meaning of this Exhibit A and the Consent Decree, will be achieved when the arithmetic average of the 20 soil sample results for each parameter, assigning all non-detect results a value of one-half the detection limit, do not exceed the values set forth in this table by more than 25 percent.
- (7) So long as the EPA-approved quantification limit for PCBs in water is above the acceptable subsurface water and stream concentrations for PCBs, compliance with the Acceptable Subsurface and Stream Concentrations for PCBs will be determined as follows: all subsurface and surface water sample results for PCBs must be below the EPA-approved quantification limit for PCBs (at the time compliance is determined).
 - (8) Modified from Superfund Public Health Evaluation Manual, October, 1986, EPA 4/540/1-86/060, OSWER Directive 9285.4-1.

674 the procedure for determining Applicable Surface Water and 675 Subsurface Water Background Concentrations. The equations for 676 calculation of the risks, supporting data and complete references are included in Appendix B. 677 678 679 The calculation of risk-based concentrations shown in Table 3-1 680 follows the procedures presented in the USEPA Draft RCRA Facility Investigation (RFI) Guidance, July, 1987, and in the USEPA 681 682 Memorandum on Interim Final Guidance for Soil Ingestion Rates, 683 January 27, 1989. In accordance with this latter reference, the soil ingestion rate for risk calculation was either 0.1 grams of : 684 soil per day for a 70 kilogram person for 70 years (for compounds) 685 686 with potency factors) or 0.2 grams of soil per day for a 17 `7 kilogram child for 5 years (for compounds with reference doses). 8 د In accordance with the RFI Guidance document referenced above, the ingestion rate used for the risk calculation was 2 liters of 690 water per day by a 70 kg person for 70 years. 691 692 Three columns of data, corresponding to Acceptable Concentrations 693 for Subsurface Water, Stream and Soil are presented in Table 3-1. 694 Additionally, Applicable Subsurface Water Background 695 Concentrations, and Applicable Surface Water Background 696 Concentrations are defined in Table 3-1. The Acceptable 697 Subsurface Water Concentrations are based on either drinking 698 water standards or criteria (Maximum Contaminant Level [MCL], proposed Maximum Contaminant Level Goal [MCLGP], lifetime 699 700 drinking water health advisory [LDWHA]) or the appropriate riskbased concentration. These limits assume, as a worst case, that 701 the subsurface water in the till could be utilized as a lifetime 702 source of drinking water. However, the use of the subsurface 703 " water in the till as a source of drinking water was rejected as

unlikely in the ECC Remedial Investigation (RI), page 6-22. As

707	standard	s based upon daily, long-term human consumption of the
,708	till wat	er for Cleanup Standards under this Remedial Action Plan
709	represen	ts an extremely conservative assumption when the real-
710	life ris	ks, if any, presented by the ECC site are considered.
711		
712	The Acce	ptable Stream Concentrations are taken from the Record of
713	Decision	(ROD) for the site, dated September 25, 1987.
714		
71 5	The Acce	ptable Soil Concentrations in Table 3-1 are based on the
716	lowest o	f the risk-based concentrations for soil or subsurface;
717	water in	gestion, from Tables B5 and B6.
718		
719	Table 3-	2 presents the compounds detected in soils at the site at
720	levels al	pove the Acceptable Soil Concentrations specified in
721	Table 3-	1. Table 3-3 shows the vapor pressure and solubility of
722	these con	pounds.
723		
724	3.3	Additional Work
725		
726	If Addit	ional Work is required under Section VII of the Consent
727	Decree, S	Settling Defendants shall perform the following
728	additiona	al work at the site unless the parties agree otherwise:
729		
730	0	Maintain the RCRA-compliant (Subtitle C)
731		cover and the access restrictions.
732		
733	0	Construct a subsurface water interception
734		trench around the south and east sides of the
735		ECC site as depicted in Figures 3-1 and 3-2.
736		
37	0	Collect and transport subsurface water

706 a result, the use of drinking water standards and risk-based



.

TABLE 3-2
COMPOUNDS DETECTED IN THE SOIL AT CONCENTRATIONS
ABOVE THE ACCEPTABLE SOIL CONCENTRATIONS (1)

Compound	Acceptable Soil Concentration (ug/kg)	Maximum Detected Concentration (ug/kg)
VOLATILE ORGANICS (VOCs):		
Acetone	490	650,000
Chloroform	2,300	2,900
1,1-Dichloroethane	5.7	35,000
1,1-Dichloroethene	120	380 :
Ethylbenzene	234,000	1,500,000 🖡
Methylene Chloride	20	310,000
Methyl Ethyl Ketone	75	2,800,000
Methyl Isobutyl Ketone	8,900	190,000
Tetrachloroethene	130	650,000
Toluene	238,000	2,000,000
1,1,1-Trichloroethane	7,200	1,100,000
1,1,2-Trichloroethane	22	550
Trichloroethene	240	4,800,000
Total Xylenes	195,000	6,800,000
BASE NEUTRAL/ACID ORGANICS:		
Phenol	9,800	570,000

(1) Acceptable Soil Concentrations are determined in accordance with Footnotes 5 and 6 of Table 3-1.

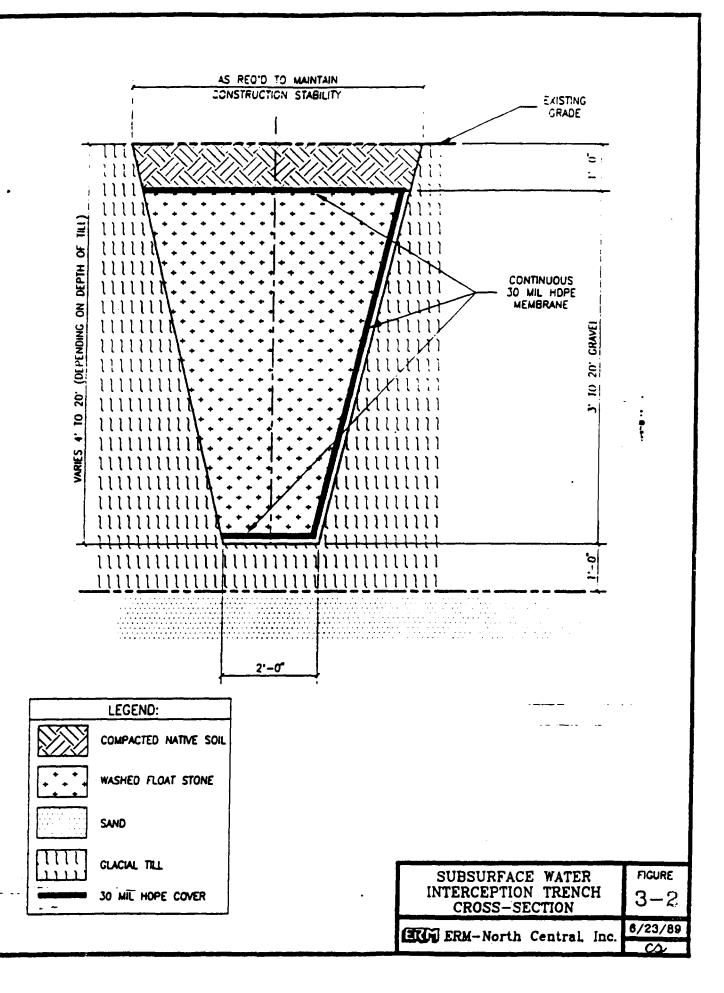
TABLE 3-3
CHEMICAL PROPERTIES OF ORGANIC COMPOUNDS
DETECTED IN THE SOILS AT CONCENTRATIONS
ABOVE THE ACCEPTABLE SOIL CONCENTRATIONS (1)

Compound	Solubility (ug/l)	Vapor Pressure (mm Hg)
VOLATILE ORGANICS (VOCs):		
Acetone	1,000,000,000	270
Chloroform	8,200,000	151
1,1-Dichloroethane	5,500,000	182
1,1-Dichloroethene	2,250,000	600
Ethylbenzene	152,000	7
Methylene Chloride	20,000,000	362
Methyl Ethyl Ketone	268,000,000	77 .5 .
Methyl Isobutyl Ketone	17,000,000	6
Tetrachloroethene	200,000	17.8
Toluene	535,000	28.1
1,1,1-Trichloroethane	4,400,000	123
1,1,2-Trichloroethane	4,500,000	30
Trichloroethene	1,100,000	57.9
Total Xylenes	198,000	10
BASE NEUTRAL/ACID ORGANICS:	•	
Phenol	93,000,000	0.341

(1) Acceptable Soil Concentrations are determined in accordance with Footnotes 5 and 6 of Table 3-1.

REFERENCES:

- U.S. EPA, "Superfund Public Health Evaluation Manual," 1986.
- U.S. EPA, "Water-Related Environmental Fate of 129 Priority Pollutants," December 1979.



738 intercepted in this trench to the
739 Indianapolis POTW (via the NSL pipeline or
740 tank truck), or provide other appropriate
741 handling and treatment of such water in
742 accordance with applicable Federal, State and
743 local requirements.

`51

2ر

o Subsurface water will continue to be removed and handled in this manner until "confirmed" analytical results from two consecutive, semi-annual subsurface water samples collected from the interception trench show that the Acceptable Stream Concentrations in Table 3-1 or Applicable Surface Water Background Concentrations have been met, unless the Parties to the Decree otherwise agree.

 o Semi-annual monitoring of off-site wells and surface water will continue for five years after the Acceptable Stream Concentrations in Table 3-1 or Applicable Surface Water Background Concentrations have been achieved.

If "confirmed" analytical results from two consecutive semi-annual samples collected during the 5 years of off-site monitoring in either the surface water or the wells indicate that the same parameter exceeds its Acceptable Stream Concentration or Applicable Surface Water Background Concentration at the same monitoring point, then subsurface water collection and treatment will be reinstituted.

770 771 As used in this section and in section 4.3 below, the term "confirmed" shall permit the Parties to demonstrate that an 772 773 analytical result is not accurate as a result of errors in sampling, analysis, or evaluation or that it otherwise 774 775 mischaracterizes the concentration of a parameter. 776 procedures used to obtain "confirmed" data shall include 777 reanalysis, resampling and the analysis of only undiluted samples 778 if a concentration is qualified with a "J" (estimated 779 concentration). If after reanalysis and/or resampling using an undiluted sample the concentration of a compound is still 780 781 qualified with a "J", then the result produced from undiluted 782 samples will be used. "B" qualified samples results will be 33 considered as "confirmed" data only if the concentrations in the sample exceed ten times the maximum amount detected in any blank . 84

786

785

787

788 4.0 REMEDIAL ACTION VERIFICATION AND COMPLIANCE MONITORING

for the media being analyzed.

789

790 The soil vapor extraction system described herein is designed to 791 achieve the cleanup standards for VOCs as presented in Table 3-1 792 and phenol. The time required to accomplish this removal depends on the type of compound and soil, air flow rate and temperature, 793 794 and on an efficient diffusion of air through the soil pores. 795 time required for treatment was estimated using a vapor extraction model, as described below and in Appendix C. 796 797 Monitoring of vapor from the combined vapor stream and from 798 individual trenches, as described below, will also be used to estimate completion of the soil vapor extraction system 799

operation. Afterwards, verification of soil cleanup will be accomplished by: (1) soil vapor monitoring of restart spikes;

sampling ("Soil Cleanup Verification"). 803 804 Compliance monitoring will consist of sampling of surface water 805 806 in Unnamed Ditch, and sampling of subsurface water in off-site 807 till and sand and gravel monitoring wells and on-site till 808 monitoring wells ("Compliance Monitoring"). 809 810 4.1 Estimation of Completion of Vapor Extraction 811 812 System Operation 813 A computer model which simulates the vapor extraction system was 814 `15 used to estimate the time required for removal of the maximum detected soil concentrations to the Acceptable Soil 16 Concentrations specified in Table 3-1. 817 Appendix C summarizes the characteristics of the model and the data used. Based on the 818 model results, the Settling Defendants expect that after one 819 820 year of operation, all the VOCs and phenol will be below the 821 Acceptable Soil Concentrations in Table 3-1 in a "worst case" 822 soil element which contains all the compounds at their maximum 823 detected concentrations. 824 825 The vapor extraction system is designed to permit vapor samples 826 to be obtained from each individual extraction trench and from the combined vapor stream from all operating extraction trenches. 827 828 829 The combined vapor flow will be sampled daily during the first 830 week of operation, weekly for the following 4 weeks, and monthly thereafter. Samples will be analyzed for VOCs listed in Table 3-831 832 1 and phenol. Also, the vapor flow rate will be monitored and recorded to provide sufficient data to calculate the mass of

(2) on-site subsurface till water monitoring; and (3) soil

organics removed from the soils and the effectiveness of the 835 These data will also aid in estimating the treatment 836 time remaining, based on the calculated mass extraction rate (lbs/day) of the VOCs listed in Table 3-1 and phenol. 837 838 839 Vapor samples from individual extraction trenches will be 840 collected at the beginning of the vapor extraction system 841 operation to establish a baseline of organics removal per trench. 842 These samples will be analyzed for the VOCs listed in Table 3-1 843 and phenol. Once the mass rate extracted per day is reduced to 5 844 percent of the initial week's rate, additional vapor samples of 845 individual trenches will be collected at least every two months. to determine when individual extraction trenches can be shut 846 The criterion for shutting down individual trenches will `47 be that two consecutive air samples from an individual trench .48 849 show vapor concentrations to be in equilibrium with the 850 Acceptable Soil Concentrations in Table 3-1. Table 4-1 shows the 851 soil vapor concentrations in equilibrium with the Acceptable Soil 852 Concentrations for the VOCs listed in Table 3-1 and phenol.

855

853

854

834

4.2 Soil Cleanup Verification

equilibrium vapor concentrations.

856 857

858 Verification of soil cleanup will be established when each of the 859 following is met: (1) the soil vapor from the restart spike tests 860 shows compliance with the calculated soil vapor concentrations in 861 equilibrium with Acceptable Soil Concentrations for the VOCs listed in Table 3-1 and phenol ("Soil Vapor Criterion"); (2) on-862 863 site till wells show compliance with the Acceptable Subsurface 064 Water Concentrations specified in Table 3-1 or Applicable Subsurface Water Background Concentrations ("Onsite Till Water

Appendix D presents the methodology used to arrive at these

TABLE 4-1 SOIL VAPOR CONCENTRATIONS IN EQUILIBRIUM WITH ACCEPTABLE SOIL CONCENTRATIONS (1)

	Soil Vapor Concentration (3)		
Compound (2)	(mg/l)	ppmv	
VOLATILE ORGANICS (VOCs):			
Acetone	0.613	254	
Chloroform	2.46	496	
1,1-Dichloroethane	0.014	3.4	
1,1-Dichloroethene	2.045	515	
Ethylbenzene	37	9,316	
Methylene Chloride	0.079	22.4	
Methyl Ethyl Ketone	0.039	13	
Methyl Isobutyl Ketone	0.685	233	
Tetrachloroethene	0.116	16.8	
Toluene	107	36,556	
1,1,1-Trichloroethane	8.29	2,819	
1,1,2-Trichloroethane	0.0060	1.1	
Trichloroethene	0.39	71.5	
Total Xylenes	26.2	4,794	
BASE NEUTRAL/ACID ORGANICS:			
Phenol	0.0053	1.4	

- (1)
- Acceptable Soil Concentrations are determined in accordance with Footnotes 5 and 6 of Table 3-1. Compounds above acceptable soil concentrations in Table 3-1 to be removed by vapor extraction. From Appendix D. (2)
- (3)

Criterion"); and (3) soil samples show compliance with the
Acceptable Soil Concentrations as specified in Table 3-1 ("Soil
Sample Criterion"). If Soil Cleanup Verification is not
established, vapor extraction will be restarted. If after five
years from the initial commencement of soil vapor extraction (or
sooner as permitted in the Decree), Soil Cleanup Verification has
not been established, then the Additional Work provisions of
Section VII of the Consent Decree will apply.

874 875

4.2.1 Soil Vapor Criterion

876

877 Once the combined vapor flow and individual trench vapor samples show concentrations of Table 3-1 VOCs and phenol at or below their respective equilibrium soil vapor concentrations shown in Table 4-1, the "restart spike" method on the combined vapor flow will be used to demonstrate that the Soil Vapor Criterion for Soil Cleanup Verification has been achieved.

883

884 The "restart spike" method consists of periodically shutting down and restarting the vapor extraction system. By shutting down the 885 system, equilibrium conditions between the vapor space within the 886 887 soil and any remaining organics amenable to vapor extraction 888 within the soil matrix are re-established. Therefore, when the 889 vapor extraction system is restarted, the initial organics 890 concentration in the extracted gas will be higher than under 891 normal operation.

892

893 The restart spike procedure will include shutting down the vapor 894 extraction system for a period of three days. Upon restarting 895 the vapor extraction system, all extraction and injection 6 trenches will be operated as during normal operation. A sample of the combined soil vapor will be collected over a five-hour

period starting 30 minutes after restarting the vapor extraction system. This sample will be representative of the soil vapor concentrations in equilibrium with the soil concentrations, because at 500 SCFM, the vapor extraction system will exchange one pore volume of soil every five hours.

903

The Soil Vapor Criterion will be met when analyses of soil vapor samples collected from four consecutive restart spikes conducted once every two weeks show that concentrations of VOCs and phenol in Table 3-1 are at or below equilibrium soil vapor concentrations shown in Table 4-1 and therefore by calculation can be shown to be at or below the Acceptable Soil

Concentrations in Table 3-1.

911

4.2.2 On-site Till Water Criterion

912 913

914 Samples of the subsurface water from the on-site till monitoring 915 wells will be collected quarterly during operating of the soil 916 vapor extraction system. The most recent quarterly sampling 917 results from the four on-site till water monitoring wells 918 following demonstration that the Soil Vapor Criterion has been 919 achieved (Section 4.2.1) will be used to demonstrate that the On-920 site Till Water Criterion for Soil Cleanup Verification has been 921 achieved.

922

923 This criterion will be met when analyses of the water samples 924 collected from each of the four on-site till wells show that the 925 concentrations for parameters with Acceptable Subsurface Water 926 Concentrations in Table 3-1 are at or below the Acceptable 927 Subsurface Water Concentrations in Table 3-1 or Applicable 928 Subsurface Water Background Concentrations.

4.2.3 Soil Sample Criterion

930 931

932 Once the Soil Vapor Criterion and Onsite Till Water Criterion for Soil Cleanup Verification have been demonstrated as defined 933 934 above, a total of twenty (20) soil samples from areas selected by 935 EPA and the State will be collected. These twenty (20) will be 936 selected as follows: sixteen soil samples will be from "hot" 937 spot areas and four non-background samples will be from randomly 938 selected points elsewhere onsite. The total number of soil 939 samples used to demonstrate that the Soil Sample Criterion for 940 Soil Cleanup Verification will not exceed 20. Each soil sample : will be analyzed for the VOCs in Table 3-1 and phenol. 941 Verification of this criterion for all VOCs in Table 3-1 and 942 ~43 phenol relative to the Acceptable Soil Concentration in Table 3-If the results from this initial round of soil samples verify .4 945 that the Acceptable Soil Concentrations in Table 3-1 have been met, then the Soil Sample Criterion for Soil Cleanup Verification 946 947 will have been achieved.

948

949 In the event that the soil sampling results do not verify that 950 the Acceptable Soil Concentrations as defined in Table 3-1 have 951 been met, and the soil vapor extraction system is operated for an additional period of time, an additional 20 soil samples must be 952 taken in the same approximate locations (i.e., within a 3-foot 953 954 radius) as the initial sample locations. Results from this second sampling will be analyzed using the identical procedure 955 956 outlined above to verify that the Acceptable Soil Concentrations 957 in Table 3-1 as described in Footnote 6 of Table 3-1 have been If the results from any subsequent round of soil samples 958 demonstrate that the Acceptable Soil Concentrations in Table 3-1 959 960 have been met, then the Soil Sample Criterion for Soil Cleanup Verification will have been achieved.

963 4.3 Post Soil Cleanup Compliance Monitoring 964 Once Soil Cleanup Verification has been achieved as prescribed in 965 966 Section 4.2, sampling of off-site till wells, on-site till wells, 967 off-site sand and gravel wells and surface water will be 968 conducted for seven years on a semi-annual basis. 969 970 Off-site wells and surface water will be analyzed for the 971 parameters with Acceptable Stream Concentrations in Table 3-1. 972 Onsite wells will be analyzed for parameters with Acceptable 973 Subsurface Water Concentrations in Table 3-1. 974 975 If "confirmed" analytical results from two consecutive semi-,76 annual samples collected during the Compliance Monitoring period 977 indicate that the same parameter exceeds its Cleanup Standard (or the Applicable Surface Water or Subsurface Water Background 978 979 Concentration) at the same monitoring point, then the Additional 980 Work provisions of Section VII of the Decree will apply. If the 981 conditions set forth in the preceding sentence do not occur, monitoring will be discontinued at the end of the Compliance 982 983 Monitoring period and the provisions of Section XXVI of the 984 Decree will apply. 985 5.0 MISCELLANEOUS PROVISIONS AND SCHEDULING 986 987 988 The following documents have been submitted to EPA and the State for review and approval by EPA: (1) Health and Safety Plan, (2) 989 Field Sampling Plan, and (3) Quality Assurance Project Plan. 990 991 Construction drawings and contract specifications will be submitted to EPA and the State within three months from the entry 992 of the Consent Decree. Comments provided by EPA and the State

962

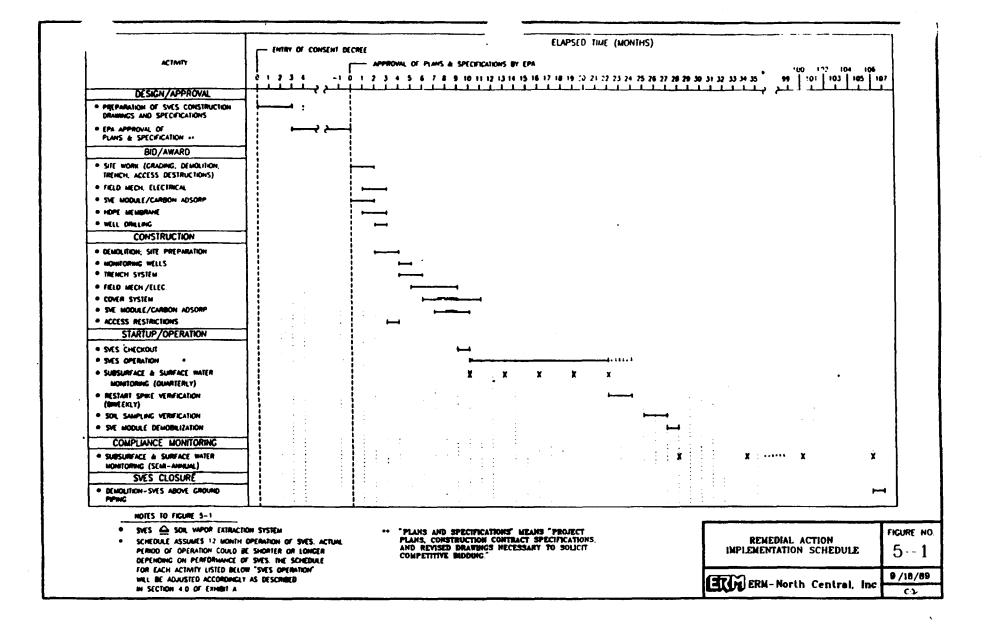
will be addressed by the Settling Defendants. 995 996 Figure 5-1 sets forth the Remedial Action Implementation Schedule 997 for implementing the remedy required under the Consent Decree. 998 The following milestones have been established in Section XVII 999 (Stipulated Penalties) of the Consent Decree: 1000 1001 Submission of the project plans, construction 1002 contract specifications and revised drawings 1003 necessary to solicit competitive bidding 1004 within 3 months from the entry of the Decree. 1005 1006 Completion of site preparation, including 0 107 grading, removal of the tanks and buildings, repair or moving of the fence, 4 months after **1008** approval by EPA all of the above referenced 1009 documents. Completion of the site 1010 1011 preparation shall mean that all hindrances, obstructions or obstacles to construction and 1012 1013 security of the soil vapor extraction 1014 trenches, monitoring wells or cap have been 1015 removed. 1016 1017 0 Completion of installation of the on-site and 1018 off-site monitoring wells 5 months after 1019 approval by EPA of all of the above 1020 referenced documents. 1021 1022 Startup of the soil vapor extraction system 0

10 months after approval by EPA of all of the

above referenced documents.

1023

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.....

1026	o	Completion of the installation of all		
1027		components of the RCRA-compliant (Subtitle C)		
1028		cover 11 months after approval by EPA of all		
1029		of the above referenced documents.		
1030				
1031	0	Submission of all documents necessary to		
1032		perform Additional Work that may be required		
1033		under Section VII of the Consent Decree 6		
1034		months after written notice has been provided		
1035		by EPA or Settling Defendants that Additional	•	
1036		Work needs to be implemented.	· <u>:</u>	
1037			Ę	
1038	0	Completion of installation of the subsurface		
1039		water interception trench on a schedule to be		
1040		determined by EPA after consultation with the		
1041		State.		

APPENDICES

APPENDIX A

ESTIMATE OF MASS OF ORGANICS IN THE SOILS TO BE REMOVED BY VAPOR EXTRACTION

APPENDIX A
ESTIMATE OF MASS OF ORGANICS IN THE SOILS
TO BE REMOVED BY VAPOR EXTRACTION

Location	Sampling depth (ft)	Assumed contamination depth (ft)	Total concentration (ug/kg)	Mass (1b)
TP-1 TP-2 TP-3 TP-4 TP-5 TP-5 TP-6 TP-6 TP-6 TP-7	1 - 1.5 1 - 1.5 1 - 2 2.5 - 3.5 1 - 2 2 - 3 1 - 2 2 - 3 4 - 5 1 - 2.5	2 2 2 2.5 4 2 1.5 1.5 2.5	1,972 28 108,800 99,730 4,416 24,287 291 12,468,000 22,690 2,416 267,000	0.271 0.004 14.978 17.162 1.216 3.343 0.030 1,716.410 2.343 0.249 45.946
TP-7 TP-8 TP-9 TP-9 TP-10 TP-10 TP-11 TP-11 TP-12 TP-12	2.5 - 4 1 - 2.5 2.5 - 4 1 - 3 3 - 5 1 - 3 3 - 5 1 - 3 3 - 5 1 - 3 3 - 5	2 2.5 2 3 2.5 3 2.5 3 2.5	280,090 3,687 433,600 14,604,000 130 958 432 130 67 35,030 3,609	38.559 : 0.634 • 59.692 * 3,015.694
SB-01 SB-02 SB-03 SB-04 SB-06 SB-08 SB-09 SB-01 SB-02 SB-04 SB-08 SB-09	2.5 - 4 2.5 - 4 2.5 - 4 2 - 3.5 2 - 3.5 2 - 3.5 2 - 7 5 - 7 5 - 7 5 - 7 5 - 7	3 3 2.5 2.5 3 3 2 2 2 2	3,303 12,900 70,070 175 222,010 3,012 61,490 27 34 51 188 8,069	0.682 2.664 14.469 0.030 38.204 0.622 12.698 0.004 0.005 0.007 0.026 1.111

TOTAL ORGANICS TO BE REMOVED BY VAPOR EXTRACTION, 1b 4,995

^{*} The area contaminated is assumed to be a 25'x25' square around each sampling location. TP = test pit; SB = soil boring. Soil concentrations from ECC RI, Section 4.

APPENDIX B

CALCULATION OF RISK-BASED CLEANUP STANDARDS

APPENDIX B

CALCULATION OF RISK-BASED CLEANUP STANDARDS

The equations used to calculate risk-based concentrations are shown in Table B1. The ingestion rates and acceptable risks are listed in Table B2. The potency factors and references doses for compounds without any regulatory or background level are from a memorandum from the USEPA Toxics Integration Branch, OERR, Washington, D.C., dated December 19, 1988, with the Corrections to the July, 1988 Update of the Characterization Tables in the Superfund Public Health Evaluation Manual.

Table B3 presents the calculation of risk-based acceptable subsurface water concentrations in the till for compounds without a regulatory limit (drinking water Maximum Contaminant Level, Maximum Contaminant Level Goal or lifetime health advisory or a stream criterion as listed in Table 1 of the Record of Decision for the site). Table B4 shows that the resulting concentrations of inorganic compounds at Unnamed Ditch should be below the Stream Criteria presented in Table 1 of the Record of Decision (ROD) for the site, dated September 25, 1987. The dilution obtained from discharge of the subsurface water in the till to Unnamed Ditch is 1:1800, as presented in Appendix C of the ECC Remedial Investigation. Note that most of the calculated concentrations in the ditch are below detection limits.

WHS:

Tables B5 and B6 list the acceptable risk-based soil concentrations, based on soil and subsurface water ingestion, respectively. The calculation of acceptable soil concentrations based on subsurface water ingestion follows the procedures presented in Appendix C of the ECC RI. Only those organic compounds without regulatory limit (USEPA, Polychlorinated

TABLE 81 EQUATIONS USED TO CALCULATE RISK-BASED CONCENTRATIONS *

SOIL (concentrations in ug/kg):

Risk * Body Weight (kg) * 1000 (ug/mg) * 1000 (g/kg)

Ingestion rate (g/d) * Potency Factor (mg/kg/d)-1

or

Risk * Body Weight (kg) * Reference Dose (mg/kg/d) * 1000 (ug/mg) * 1000 (g/kg)

Ingestion rate (g/d)

SUBSURFACE WATER (concentrations in ug/t):

Risk * Body Weight (kg) * 1000 (ug/mg)

Ingestion rate (I/d) * Potency Factor (mg/kg/d)-1

or

Risk * Body Weight (kg) * Reference Dose (mg/kg/d) * 1000 (ug/mg)

Ingestion rate (I/d)

TABLE B2 INGESTION RATES AND ACCEPTABLE RISKS

INGESTION RATES * :
soils:
0.1 grams per day by a 70-kilogram person for 70 years
or
0.2 grams per day by a 17-kilogram child for 5 years
SUBSURFACE WATER:
2 liters of water per day by a 70-kilogram person for 70 years
CCEPTABLE RISKS:
COMPOUNDS WITH POTENCY FACTORS:
· -6
10

* From U.S. EPA, RCRA Facility Investigation Guidance, 1987, and U.S. EPA, Office of Solid Waste and Emergency Response, Hemorandum on Interim Final Guidance for Soil Ingestion Rates, January 27, 1989.

COMPOUNDS WITH REFERENCE DOSES:

TABLE 83
ECC - ACCEPTABLE MEALTH-BASED SUBSURFACE WATER CONCENTRATIONS

Compound (1)	Potency Factor (2) (mg/kg/d)-1	Reference Dose (2) (mg/kg/d)	Acceptable Health-Based Subsurface Water Concentration (3) (ug/l)
VOLATILE ORGANICS (VOCs):			
Acetone		0.1	3,500
1,1-Dichloroethane	0.091	U. 1	0.38
Methylene Chloride	0.0075		4.7
Methyl Isobutyl Ketone	0.0073	0.05	1,750
Tetrachioroethene	0.051	0,122	0.69
1,1,2-Trichloroethane	0.057		0.61
BASE NEUTRAL/ACID ORGANICS:			
. Bis(2-ethylhexyl)phthalate	0.014		2.5
Di-n-Butyl Phthalate		0.1	3,500
Diethyl Phthalate		0.8	28,000
Isaphorone	0.0041	•	8.5
Naphthalene		0.4	14,000
Phenol		0.04	1,400
PESTICIDES/PCBs:			
Aroctor-1232	7.7		0.0045
Aroctor-1260	7.7		0.0045
INORGANICS:		ė.	
Antimony		0.0004	14
Beryllium		0.005	175
Nanganese		0.2	7,000
tin		0.6	21,000
Vanadium		0.007	245
Zinc		0.2	7,000

- (1) Only compounds without a regulatory limit (drinking water Maximum Contaminant Level [40 CFR 141], Maximum Contaminant Level Goal or lifetime health advisory) are shown.
- (2) From USEPA Toxics Integration Branch, OERR, Washington, D.C. December 1988 correction to the July 1988 Update of the Risk Characterization Tables in the Superfund Public Health Evaluation Hanual.
- (3) Acceptable subsurface water concentrations calculated using an ingestion rate of 2 liters per day by a 70 kg adult for 70 years. Acceptable risk = 1E-06 for compounds with potency factor and 1 for compounds with reference dose.

TABLE B4 COMPARISON OF ACCEPTABLE STREAM CONCENTRATIONS WITH STREAM CONCENTRATIONS BASED ON NATURAL DISCHARGE OF SUBSURFACE WATER FROM THE TILL

Compounds (1)	Acceptable Stream Concentration (1) (ug/1)	Concentratic Unnamed Ditc to Discharge c Water at Accep Concentration (ug/1)
VOLATILE ORGANICS (VOCs): Chloroform 1,1-Dichloroethene Ethylbenzene Methylene Chloride Tetrachloroethene Toluene 1,1,1-Trichloroethane 1,1,2-Trichloroethane Trichloroethene	15.7 1.85 3,280 15.7 8.85 3,400 5,280 41.8 80.7	0.056 0.0039 1.9 0.0026 0.00038 5.8 0.11 0.00034 0.0028
BASE NEUTRAL/ACID ORGANICS: Bis(2-ethylhexyl)phthalate Di-n-Butyl Phthalate Diethyl Phthalate Naphthalene Phenol	50,000 154,000 52,100 620 570	0.0014 1.9 15.6 7.8 0.78
INORGANICS: Arsenic Chromium Lead Nickel Zinc Cyanide	0.0175 11 10 100 47 5.2	0.028 0.028 0.028 0.39 3.9 0.39

(1)

From Table 1 of the Record of Decision (ROD) for the site, September 25, 1987. Only those compounds detected in ECC soil samples that are listed in this table are shown. Assuming a dilution of 1:1800 for natural discharge of till water at acceptable concentrations into Unnamed Ditch (from ECR Remedial Investigation, Appendix C).

TABLE 85
ECC - ACCEPTABLE SOIL CONCENTRATIONS BASED ON SOIL INGESTION

Compounds (1)	Potency Factor (2) (mg/kg/d)-1	Reference Dose (2) (mg/kg/d)	Acceptable Soil Concentrations Based on Soil Ingestion (3) (ug/kg)	Range of Acceptable Soil Concentrations Based on Soil Ingestion (4) (ug/kg)
VOLATILE ORGANICS (VOCs):				
Acetone		0.1	8,500,000	8,500,000
Chlorobenzene		0.03	2,550,000	2,550,000
Chloroform	0.0061	0.03	114,754	11,475-11,475,400
1,1-Dichloroethane	0.091		7,692	769-769,200
1,1-Dichtoroethene	0.6		1,167	116.7-116,700
Ethylbenzene	0.0	0.1	8,500,000	8,500,000
Methylene Chloride	0.0075	•••	93,333	9,333-9,333,300
Hethyl Ethyl Ketone	*******	0.05	4,250,000	4,250,000
Methyl Isobutyl Ketone		0.05	4,250,000	-,250,000
Tetrachloroethene	0.051		13,725	1.373-1.372.500
Toluene		0.3	25,500,000	25,500,000
1,1,1-Trichloroethane		0.09	7,650,000	7,650,000
1,1,2-Trichloroethane	0.057	•	12,281	1,228-1,228,100
Trichloroethene	0.011		63,636	6,364-6,363,600
Total Xylenes		2	170,000,000	170,000,000
BASE NEUTRAL/ACID ORGANICS:				
Bis(2-ethylhexyl)phthalate	0.014		50,000	5,000-5,000,000
Di-n-Butyl Phthalate		0.1	8,500,000	8,500,000
Diethyl Phthalate		0.8	68,000,000	68,000,000
Isophorone	0.0041		170,732	17,073-17,073,200
Naphthalene		0.4	34,000,000	34,000,000
Phenol		0.04	3,400,000	3,400,000

NOTES:

- (1) Only organic compounds without a regulatory limit in soils (USEPA, "Polychlorinated Biphenyls Spill Cleanup Policy Rule," 40 CFR Part 761) are shown.
- (2) From USEPA Toxics Integration Branch, DERR, Washington, D.C. December 19, 1988, "Corrections to the July 1988 Update of the Characterization Tables in the Superfund Public Health Evaluation Manual."
- (3) Intake for compounds with potency factor: 0.1 g of soil/d by 70 kg resident adults. Intake for compounds with reference dose: 0.2 g of soil/d by 17 kg resident children. Acceptable risks: 18-06 for compounds with potency factor; 1 for compounds with reference dose.
- (4) Range shown is for risks of 10-4 to 10-7 for compounds with potency factor. The value shown for compounds without potency factor is for a risk of 1.

TABLE 86 (Page 1 of 2)

ECC - ACCEPTABLE SOIL CONCENTRATIONS BASED ON THEORETICAL SUBSURFACE WATER INGESTION AT THE SITE (10-6 RISK)

Compound (1) VOLATILE ORGANICS (VOCs):	Solubility (2) (ug/l)	Log Kow (2)	Kd (3)	Acceptable Subsurface Water Concentration (4) (ug/l)	Acceptable Leachate Concentration (5) (ug/l)	Acceptable Soil Concentration Based on Water Ingestion (6) (ug/kg)
Acetone Chlorobenzene Chloroform 1,1-Dichloroethane 1,1-Dichloroethane 1,1-Dichloroethane Ethylbenzene Methylene Chloride Methyl Ethyl Ketone Methyl Isobutyl Ketone Tetrachloroethane 1,1,1-Trichloroethane 1,1,2-Trichloroethane Trichloroethene Total Xylenes ASE NEUTRAL/ACID ORGANICS: Bis(2-ethylhexyl)phthalate Di-n-Butyl Phthalate Diethyl Phthalate Isophorone Naphthalene Phenol	1,000,000,000 466,000 8,200,000 5,500,000 2,250,000 152,000 20,000,000 268,000,000 17,000,000 200,000 4,400,000 4,500,000 1,100,000 198,000 13,000 4,320,000 12,000 30,000 93,000,000	-0.24 2.84 1.97 1.79 1.84 3.15 1.25 0.26 2.88 2.69 2.17 2.17 2.29 3.26 8.7 5.2 3.22 3.01 1.46	0.00071 0.858 0.116 0.076 0.086 1.75 0.022 0.00226 0.02604 0.941 0.607 0.183 0.183 0.242 2.26 621472 197 2.06 0.031 1.269 0.035	3,500 RB 60 MCLGP 100 MCL -0.38 RB 7 MCL 680 MCLGP 4.7 RB 170 LDWHA 1,750 RB 0.69 RB 2,000 MCLGP 200 MCL 0.61 RB 5 MCL 440 MCLGP 2.5 RB 3,500 RB 28,000 RB 8.5 RB 14,000 RB	686,275 11,765 19,608 74.5 1,373 133,333 922 33,333 343,137 135 392,157 39,216 120 980 86,275 490 686,275 5,490,196 1,667 2,745,098 274,510	490 10,093 2,269 5,7 118 233,540 20.3 75 8,935 127 238,167 7,193 21.9 237 194,672 304,643,220 134,871,303 11,298,207 51.7 3,685,209

TABLE B6 (Page 2 of 2)

ECC - ACCEPTABLE SOIL CONCENTRATIONS BASED ON THEORETICAL SUBSURFACE WATER INGESTION AT THE SITE (10-6 RISK)

- (1) Only organic compounds without a regulatory limit in soils (USEPA, "Polychlorinated Biphenyls Spill Cleanup Policy Rule,"
 40 CFR Part 761) are shown.
- (2) From ECC RI, Table 5-3, and Verschueren, 1983, "Hendbook of Environmental Data on Organic Chemicals".
- (3) From ECC RI, Table 5-3. Calculated as 10°log Kow * OC, where OC= organic carbon content = 0.00124. For isophorone and methyl isobutyl ketone, the Kd is obtained as Kd = Koc * OC, where Koc = organic carbon-water partition coefficient, obtained from log Koc = (-0.55 * log S) + 3.64 (Exhibit A-1 of "Superfund Public Health Evaluation Manual," 1986).
- (4) RB = risk-based concentration, from Table B3; MCL = Maximum Contaminant Level, from 40 CFR 141; MCLGP = proposed MCL goal, from 40 CFR 141; LDUNA = lifetime drinking water health advisory, from "Superfund Public Health Evaluation Namual," 1986.
- (5) Leachate discharge/subsurface water discharge = 0.0051 (Appendix C of the ECC RI; and reduction of the 7.8 in/yr recharge used in the RI under the current conditions [page 5-8] by 99 percent due to the cap).
- (6) Soil concentration (ug/kg) = Kd * Concentration in leachate (ug/l).

, para 1 4 . .

Biphenyls Spill Cleanup Police Rule, 40 CFR Part 761) in soils are listed in Tables B5 and B6. It is conservatively assumed that the volume of leachate from the soils will be reduced by 99 percent from the 7.8 in/yr used in the RI, by installing the RCRA-compliant (Subtitle C) cover over the site.

A range of acceptable soil concentrations based on water ingestion using the published ranges for organic carbon content of till soils and the SARA range of risk for Superfund site cleanups, is presented in Table B7. A list of organic carbon content in soil is shown in Table B8, with the respective reference. The concentrations shown in Table B6 were used to determine the Acceptable Soil Concentrations specified in Table 3-1, using a risk of 10⁻⁶ and a soil organic carbon content of 0.12%, as presented in the RI. This soil organic carbon content was deemed conservative when compared to the values shown in Table B8.

Table B9 lists the solubility and vapor pressure of the organic compounds detected in the soils above the limits shown in Tables B5 and B6. All compounds, except bis(2-ethylhexyl)phthalate and Aroclor-1260, are amenable to removal by soil vapor extraction.

Finally, Table B10 presents the complete list of references used for the calculation of the Acceptable Soil Concentrations specified in Table 3-1.

TABLE 87
ECC - ACCEPTABLE SOIL CONCENTRATIONS BASED ON THEORETICAL SUBSURFACE
. WATER INGESTION AT THE SITE (RANGE OF RISKS)

Acceptable Soil Concentration Based on Water Ingestion (3)

		***************************************	***************************************	
Compound (1)	Range of Kd (2)	Range for 10-4 risk	Range for 10-7 risi	k
			***************	• • • • •
VOLATILE ORGANICS (VOCs):	•			
Acetone	0.000058-0.0044	40-3,019	40-3,019 -	(4)
Chiorobenzene	0.069-5.24	814-61,600	814-61,600	(5)
Chioroform	0.0093-0.71	182-13,900	182-13,900	(5)
1,1-Dichloroethane	0.0062-8.47	46-3,500	0.046-3.50	
1,1-Dichtoroethene	0.00 69-0 .52	9.47-714	9.47-714	(5)
Ethylbenzene	0.14-10.7	18,800-1,431,000	18,800-1,431,000	(5)
Methylene Chloride	0_0018-0.14	166-12,900	0.166-12.9	
Methyl Ethyl Ketone	0.80018-0.014	6.07-461	6.07-461	(5)
Methyl Isobutyl Ketone	9_0021-0.16	721-54,900	721-54,900	(÷)
Tetrachloroethene	0.076-5.78	1,028-78,200	1.03-78.2	
Toluene	0.049-3.72	19,200-1,460,000	19,200-1,460,000	(5)
1,1,1-Trichioroethane	0.015-1.14	568-44,700	588-44,700	(5)
1,1,2-Trichloroethane	0.015-1.14	179-13,600	0.179-13.6	
Trichloroethene	0.020-1.52	19.6-1,490	19.6-1,490	(5)
Total Xylenes	0.18-13.7	15,700-1,193,000	15,700-1,193,000	(5)
BASE NEUTRAL/ACID ORGANICS:				
Bis(2-ethylhexyl)phthalate	50100-3810000	2,460,000,000-187,000,000,000	2,460,000-187,000,000	
Di-n-Butyl Phthalate	15.8-1200	10,800,000-824,000,000	10,800,000-824,000,000	(4)
Diethyl Phthalate	0.17-12.9	933,000-70,800,000	933,000-70,800,000	(4)
Isophorone	0.0025-0.19	417-31,700	0.417-31.7	
Naphthalene	0.1-7.6	275,000-20,900,000	275,000-20,900,000	(4)
Phenal	0.0029-0.22	796-60,400	796-60,400	(4)

NOTES:

- (1) Only organic compounds without a regulatory limit in soils (USEPA, "Polychlorinated Biphenyls Spill Cleanup Policy Rule," 40 CFR Part 761) are shown.
- (2) For a range of organic carbon content of 0.0001 to 0.0076 obtained from: U.S. Department of Agriculture, "Soil Classification - A Comprehensive System". Soil Conservation Service, 7th Approximation, 1960. Calculated as presented in Table 86.
- (3) Acceptable Soil Concentrations at the risk shown (for compounds with potency) for a range of organic carbon content of 0.0001 to 0.0076. Calculated as presented in Table 86.
- (4) Acceptable Soil Concentration range does not change because the compound does not have a potency factor.
- (5) Acceptable Soil Concentration range does not change because the value is based on regulatory limits (drinking water Maximum Contaminant Level, Maximum Contaminant Level Goal, or lifetime health advisory).

TABLE 88 (Page 1 of 5) ORGANIC CARBON CONTENT OF SOILS - REFERENCES

Organic Carbon Content, %	Type of Soil (depth)	Geographic Area	Reference
0.125 (avg over 1.5 acre site)	Loamy sand (4 ft)	Etimenda, CA (arid region)	Elabd, H., and M.A. Jury. 1986. "Spatial variability of Pesticide Adsorption Parameters." Environmental Science and Technology, Vol. 20, No. 3, pp. 256-260.
0.2 (avg over 1.5 acre site)	Loamy sand (2 and 3 ft)	Ibid	Ibid
0.26 (avg over 1.5 acre site)	Loamy sand (1 ft)	lbid	lbid
1.9	Silt loam	Corvallis, OR	Chiou, C.T., P.E. Porter, and D.W. Schmeddign. 1983. **Partition Equilibria of Nonionic Organic Compounds between Soil Organic Natter and Water." Environmental Science and Technology, Vol. 17, No. 4, pp. 227-231
0.15	Sand close to river	Switzerland	Schwarzenbach, R.P., and J. Westall, 1981. "Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies." Environmental Science and Technology, Vol. 15, No. 11, pp. 1360-1367.
2.1	Air-dried soil	lous	Nu, S., and P.M. Gschwend. 1986. "Sorption Kinetics of Nydrophobic Organic Compounds to Natural Sediments and Soils." Environmental Science and Technology, Vol. 20, No. 7, pp. 717-725.
0.11	Loess sample	Turin, lowa	Karickhoff, S.W. 1984. "Organic Pollutant Sorption in Aquatic Systems." Journal of Hydraulic Engineering, Vol. 110, No. 6, pp. 707-735.
1.3	Soil	fern Clyffe State Park, IL	Ibid
0.02	Aquifer water table zone 98 % sand	Borden, Canada	Abdul, A.S., T.L. Glbson, and D.N. Rai. 1986. "The Effect of Organic Carbon on the Adsorption of Fluorene by Aquifer Materials." Hazardous Waste and Hazardous Materials. Vol. 3, No. 4, pp. 429-440.
0.52	Aquifer water table zone 87 % sand	Flint, MI	lbid
1.8	Aquifer water table zone 91 % sand	flint, MI	Ibid

TABLE 88 (Page 2 of 5) ORGANIC CARBON CONTENT OF SOILS - REFERENCES

Organic Carbon Content, %	Type of Soil (depth)	Geographic Area	Reference
0.05	fine-sand soil	Wilmington, DE	Stokman, S.K. 1987. "Estimates of Concentrations of Soluble Petroleum Hydrocarbons Migrating into Ground Water from Contaminated Soil Sources." Proceedings of the National Water Well Association/American Petroleum Institute Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration. Houston, TX, pp. 541-558.
0.1	Shaly-silt soil	Philadelphia, PA	lbid
0.05	Fine to coarse sand, 96% sand	Hichigan	Chiang, C.Y., C.L. Klein, J.P. Salanitro, and H.L. Wisniewski. 1986. "Data Analyses and Computer Modelling of the Benzene Plume in an Aquifer Beneath a Gas Plant." Proceedings of the National Water Welt Association/American Petroleum Institute Conference: on Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration? Houston, TX, pp. 157-176.
0.27	Lincoln fine sand (surface soil)	Little Sandy Creek near Ada, OK	Clark, G.L., A.T. Kan, and M.B. Tomson. 1986. "Kinetic Interaction of Neutral Trace Level Organic Compounds with Soil Organic Haterial." Proceedings of the National Water Well Association/American Petroleum Institute Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration. Houston, TX, pp. 151-156.
0.74	Fine to medium grained sand (3 ft)	Indian River County, FL	Kemblowski, M.W., J.P. Salinatro, G.M. Deeley, and C.C. Stanley. 1987. "Fate and Transport of Residual Hydrocarbon in Groundwater - A Case Study." Proceedings of the National Water Well Association/ American Petroleum Institute Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration. Houston, TX, pp. 207-231.
0.44	Fine to medium grained sand (7 ft)	Indian River County, FL	Ibid
0.12	Fine to medium grained sand (13 ft)	Indian River County, FL	lbid

TABLE 88 (Page 3 of 5) ORGANIC CARBON CONTENT OF SOILS - REFERENCES

Organic Carbon Content, %	Type of Sail (depth)	Geographic Area	Reference
0.36	fine to medium grained sand (3 ft)	Indian River County, FL	lbid
0.15	Fine to medium grained sand (13 ft)	Indian River County, FL	Ibid
1.08	Fine to medium grained sand (2 ft)	Indian River County, FL	Ibid
0.16	Fine to medium grained sand (11 ft)	Indian River County, FL	[bid]
0.72	fine to medium grained sand (3 ft)	Indian River County, FL	Ibid
0.26	Fine to medium grained sand (10 ft)	Indian River County, FL	lbid .
0.74	Glacial till (1-2 ft)	Sargent County, ND	"Soil Classification - A Comprehensive System." 1960. U.S. Department of Agriculture, Soil Conservation Service, 7th Approximation.
0.33	Glacial till (2-3 ft)	Sargent County,	Ibid
0.18	Glacial till (4.5-5 ft)	Sargent County,	Ibid
0.1	Tfll (1-2 ft)	Strafford County, New Hampshire	Ibid
0.08	Tf(((2-3 ft)	Strafford County, New Mampshire	lbid
0.03	Till (4-5 ft)	Strafford County, New Hampshire	Ibid
0.01	Till (5-7 ft)	Strafford County, New Hampshire	lbid

TABLE 88 (Page 4 of 5) ORGANIC CARBON CONTENT OF SOILS - REFERENCE

Organic Carbo Content, 2	(depth)	Geograph :
0.59		• • • • • • • • • • • • • • • • • • • •
	Calcareous,	Greenbrian c.
	glacial till	West Virginia
	(1-2 ft)	**************************************
0.27	Calcareous,	_
	glacial till	- A STATE OF THE COUNTY
	(2-3 ft)	West Virginia
	(2-3 15)	
0.08	Calcareous,	Gracebaire
	glacial till	Greenbrier County,
	(4-5 ft)	West Virginia
0.38	Colora	
-	Calcareous,	Tomkins County,
	glacial till	New York
	(1-2 ft)	
0.16	Calcareous,	•
	glacial till	Tomkins County,
	(2-3 ft)	New York
	1-5117	
0.17	Calcareous,	Tomkins County,
	glacial till	New York
	(4.5-6.5 ft)	wem 10LK
0.14	Calana	
	Calcareous,	Tomkins County,
	glacial till	New York
	(6.5-7 ft)	
0.76	Glacial till	lla -
	(1-2 ft)	Waseca County,
		Minnesota
0.3	Glacial till	Waseca County,
	(2-3 ft)	Minnesota
. 19	Cleater	
-	Glacial till	Waseca County,
	(> 4 ft)	Minnesota
.51	Glacial till	_
	(1-2 ft)	Sargent County,
	** * 16)	NO
18	Glacial till	Sacrons Commission
	(2-3 ft)	Sargent County,
16		MD
10	Glacial till	Sargent County,
	(3.5-5 ft)	sein county,

発売されたことはおります。

TABLE 88 (Page 5 of 5) ORGANIC CARBON CONTENT OF SOILS - REFERENCES

Organic Carbon Content, %	Type of Soil (depth)	Geographic Area	Reference
0.64	Firm, glacial till (1-2 ft)	Spink County, SD	lbid
0.36	Firm, glacial till (2-3 ft)	Spink County, SD	Ibid
0.31	Firm, glacial till (4-5 ft)	Spink County, SD	. Ibid
0.46	Glacial till (1-2 ft)	Renville County,	Ibid
0.24	Glacial till (2-3 ft)	Renville County,	. lbid
0.13	Glacial till (4-5 ft)	Renville County, NO	lbid :
0.25	Glacial till (2-3 ft)	Adair County, Iowa	Ibid :
0.08	Glacial till (> 6 ft)	Adair County, Iowa	Ibid
0.74	Calcareous, glacial titl (1-2 ft)	Ward County, MD	lbid
0.2	Calcareous, glacial till (2-3 ft)	Ward County,	Ibid
0.19	Calcareous, glacial till (4-5 ft)	Ward County, NO	lbid
0.35	Glacial till (1-2 ft)	Cayuga County, NY	[bid]
0.1	Glacial till (2-3 ft)	Cayuga County,	Ibid
0.12	Glacial till (6-7 ft)	Cayuga County,	lbid

TABLE B9 CHEMICAL PROPERTIES OF ORGANIC COMPOUNDS DETECTED IN THE SOILS AT CONCENTRATIONS ABOVE THE ACCEPTABLE SOIL CONCENTRATIONS (1)

Compound	Solubility (ug/l)	Vapor Pressure (mm Hg)
VOLATILE ORGANICS (VOCs):		
Acetone	1,000,000,000	270
Chloroform	8,200,000	151
1,1-Dichloroethane	5,500,000	182
1,1-Dichloroethene	2,250,000	600
Ethylbenzene	152,000	7
Methylene Chloride	20,000,000	362
Methyl Ethyl Ketone	268,000,000	77.5
Methyl Isobutyl Ketone	17,000,000	6 .
Tetrachloroethene	200,000	17.8
Toluene	535,000	28.1
1,1,1-Trichloroethane	4,400,000	123
1,1,2-Trichloroethane	4,500,000	30
Trichloroethene	1,100,000	57.9
Total Xylenes	198,000	10
BASE NEUTRAL/ACID ORGANICS:	•	
Bis(2-ethylhexyl)phthalate	1,300	0.0000002
Isophorone	12,000	0.38
Phenol	93,000,000	0.341
PESTICIDES/PCBs:		
Aroclor-1260 (2)	2.7	0.0000405

Acceptable Soil Concentrations are determined in accordance with Footnotes 5, 6, and 7 of Table 3-1.
Soil limit assumed for PCBs is 10,000 ug/kg (40 CFR Part 761.125, "Polychlorinated Biphenyls Spill Cleanup Policy Rule").

REFERENCES:

U.S. EPA, "Superfund Public Health Evaluation Manual," 1986.
U.S. EPA, "Water-Related Environmental Fate of 129 Priority Pollutants," December 1979.

TABLE B10

REFERENCES

Abdul A.S., T.L. Gibson, and D.N. Rai. 1986. "The Eff Organic Carbon on the Adsorption of Fluorene by Materials." Hazardous Waste and Hazardous Materials. V No. 4, pp. 429-440.

CH2MHILL, "Environmental Conservation and Chemical Corpc Feasibility Study," December, 1986.

CH2MHILL, "Environmental Conservation and Chemical Corpc Remedial Investigation," March, 1986.

Chiang, C.Y., C.L. Klein, J.P. Salanitro, and H.L. Wisni 1986. "Data Analyses and Computer Modelling of the Benzene in an Aquifer Beneath a Gas Plant." Proceedings of the Na-Water Well Association/American Petroleum Institute Conferer Petroleum Hydrocarbons and Organic Chemicals in Ground & Prevention, Detection and Restoration. Houston, TX, pp. 157

Chiou, C.T., P.E. Porter, and D.W. Schmeddign. 1983. "Part Equilibria of Nonionic Organic Compounds between Soil Or Matter and Water." Environmental Science and Technology, 17, No. 4, pp. 227-231.

Clark, G.L., A.T. Kan, and M.B. Tomson. 1986. "Ki Interaction of Neutral Trace Level Organic Compounds with Organic Material." Proceedings of the National Water Association/American Petroleum Institute Conference on Petro Hydrocarbons and Organic Chemicals in Ground Water - Prevent Detection and Restoration. Houston, TX, pp. 151-156.

Elabd, H., and W.A. Jury. 1986. "Spatial variability Pesticide Adsorption Parameters." Environmental Science Technology, Vol. 20, No. 3, pp. 256-260.

Karickhoff, S.W. 1984. "Organic Pollutant Sorption in Aqu. Systems." Journal of Hydraulic Engineering, Vol. 110, No. 6, 707-735.

Kemblowski, M.W., J.P. Salinatro, G.M. Deeley, and C.C. Stanl 1987. "Fate and Transport of Residual Hydrocarbon Groundwater-A Case Study." Proceedings of the National Wa Well Association/American Petroleum Institute Conference Petroleum Hydrocarbons and Organic Chemicals in Ground Wat Prevention, Detection and Restoration. Houston, TX, pp. 207-2

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TABLE B10

REPERENCES

Schwarzenbach, R.P., and J. Westall. 1981. "Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies." Environmental Science and Technology, Vol. 15, No. 11, pp. 1360-1367.

Stokman, S.K. 1987. "Estimates of Concentrations of Soluble Petroleum Hydrocarbons Migrating into Ground Water from Contaminated Soil Sources." Proceedings of the National Water Well Association/American Petroleum Institute Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water-Prevention, Detection and Restoration. Houston, Tx, pp. 541-558.

Wu, S., and P.M. Gschwend. 1986. "Sorption Kinetics of Hydrophobic Organic Compounds to Natural Sediments and Soils." Environmental Science and Technology, Vol. 20, No. 7, pp. 717-725.

U.S. Department of Agriculture, Soil Conservation Service, "Soil Classification - A Comprehensive System." 1960, 7th Approximation.

USEPA, Office of Solid Waste and Emergency Response, "Memorandum on Interim Final Guidance for Soil Ingestion Rates," January 27, 1989.

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USEPA, Region V, "Record of Decision for Environmental Conservation and Chemical Corporation, and Northside Sanitary Landfill, Zionsville, Indiana," September 25, 1987.

USEPA, "Draft RCRA Facility Investigation Guidance," July, 1987, OSWER Directive 9502.00-6C.

USEPA, "National Primary Drinking Water Regulations," 40 CFR 141, last amended by 53 FR 37408, September 26, 1988.

USEPA, "Polychlorinated Biphenyls Spill Cleanup Policy Rule," 40 CFR Part 761, published in the Federal Register on April 2, 1987.

USEPA, "Superfund Public Health Evaluation Manual," October, 1986, PB87-183125 with updates of November 16, 1987 and July, 1988.

USEPA, Toxics Integration Branch, OERR, Washington, D.C., December, 1988. "Memorandum with Corrections to the July, 1988 Update of the Risk Characterization Tables in the Superfund Public Health Evaluation Manual."

TABLE B10

REFERENCES

USEPA, "Water-Related Environmental Fate of 129 Priority Pollutants," December, 1979 PB80-204381.

US Geological Survey, "Background Geochemistry of Some Rocks, Soils, Plans, and Vegetables in the Conterminous United States," Professional Paper 574-F, 1975.

Veschueren, K., "Handbook of Environmental Data on Organic Chemicals," 1983.

APPENDIX C

ECC - VAPOR EXTRACTION MODEL

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APPENDIX C

ECC - VAPOR EXTRACTION MODEL

This program was written in FORTRAN by Michael C. Marley and George E. Hoag and reported in "Induced Soil Venting for Recovery/Restoration of Gasoline Hydrocarbons in the Vadose Zone," Proceedings, Petroleum Hydrocarbons and Organic Chemicals in Ground Water Conference, Houston, TX, 1984.

The program is based on the concentration of each component in the vapor phase in the soil, using the partial pressure exerted by each compound, as expressed by the following equation:

$$ZT = \frac{VP * X * V * MW}{R * T}$$

where:

ZT = concentration of the component in the vapor phase, mg/l

VP = vapor pressure of compound, mm Hg

X = mole fraction = moles of component/total moles of organics
in soil

V = volume of element, liters

MW = molecular weight of component

R = gas constant = 82.4 atm - cm³/gmoles^OK

T = temperature = 294.25°K

The program uses the finite difference method to calculate the change in number of moles of each component during a small time interval (i) and then recalculate over the next time interval (i+1), using the reduced number of moles resulting from subtracting the change in number of moles calculated for interval i from the number of moles present in the soil at the beginning of interval i.

The program runs for a finite length of time or until all the components are removed. The program was rewritten in BASIC and applied to the ECC site.

Table C-1 shows the chemical data used to run the model. The compounds to be evaluated are those shown in Table 3-2, which are amenable to removal by vapor extraction. The maximum detected soil concentrations were taken from Section 4 of the ECC RI, while the vapor pressure and molecular weight data are from USEPA, "Superfund Public Health Evaluation Manual," 1986.

As there was significant variation of compounds concentrations between soil samples at the site, a theoretical block size was chosen. This theoretical soil block is 10 ft x 10 ft x 2 ft deep and was assumed to contain all components of interest at their maximum detected concentrations (Table C-1). Furthermore, it was conservatively assumed that the air flow through the soil would only be 15% efficient in removing the organics. In effect, this represents a worst case estimate of the time required to remove the organics from the soils. The mass of this block was estimated as 10,200 kg.

TABLE CT CHEMICAL DATA OF COMPOUNDS

Compound (1)	Molecular Weight (2)	Vapor Pressure (2) (mm Hg)	Maximum Detected Soil Concentration (3) (ug/kg)
VOLATILE ORGANICS: Acetone Chieroform 1,1-Dichloroethene 1,1-Dichloroethene Ethylbenzene Methylene Chloride Methyl Ethyl Ketone Methyl Isobutyl Ketone Tetrachloroethene Toluene 1,1,1-Trichloroethene 1,1,2-Trichloroethene Trichloroethene EASE NEUTRAL/ACID ORGANICS:	58.1 119 99 97 106 85 72.1 100 166 92.1 133 133	270 151 182 600 7 362 77.5 6 17.8 28.1 123 30 57.9	650,000 2,900 35,000 380 1,500,000 310,000 2,800,000 190,000 650,000 2,000,000 1,100,000 550 4,800,000
Phenot Isophorone	94.1 138	0.341 0.38	570,000 440,000

Recentational and a little of the latest and the la

⁽¹⁾ Compounds shown are those amenable to soil vapor extraction.

⁽²⁾ From U.S. EPA, "Superfund Public Health Evaluation Manual,"

⁽³⁾ From ECC RI, March 1986.

The air flow rate was estimated as a fraction of the total air flow rate to be used at the site (500 SCFM), based on the length of injection trench influencing the assumed soil block (10 ft) as a ratio of the total length of injection trenches (3,800 ft). This represents an air flow rate of 37.26 liters per minute.

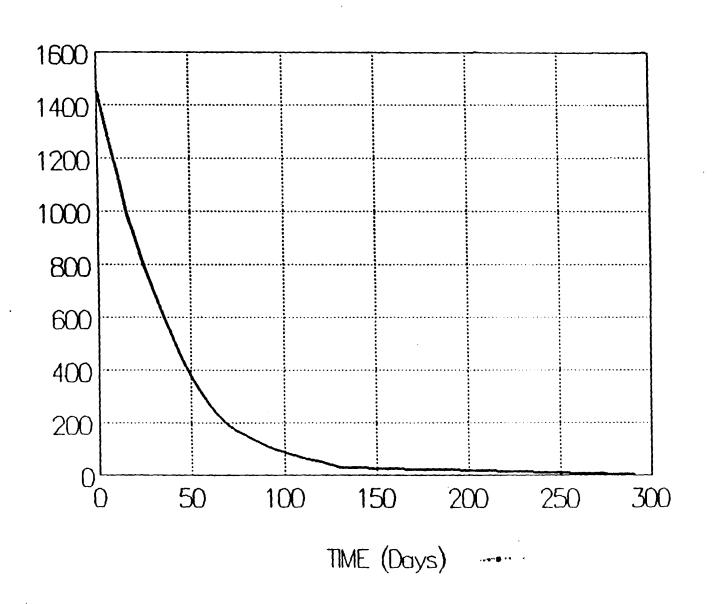
The results, summarized in Figure Cl, show that essentially no VOCs will be present in the hypothetical soil element after 130 days of soil vapor extraction. To remove phenol and isophorone to the Acceptable Soil Concentrations in Table 3-1, operation of the vapor extraction system for a total of approximately 360 days is necessary.

Actual large-scale soil vapor extraction systems have been operated with excellent removals of compounds such as tetrachloroethene, trichloroethene, 1,3-dichloropropene, methyl ethyl ketone, methyl isobutyl ketone, toluene, and xylenes. Some published references are:

- o Lisiecki, J.B., and F.C. Payne. "Enhanced Volatilization: Possibilities, Practicalities, and Performance." Presented at the Engineering Foundation Conference, Mercersburg, PA, August 7-12, 1988.
- o Regalbuto, D.P., J.A. Barrera and J.B. Lisiecki. "In-Situ Removal of VOCs by Means of Enhanced Volatilization." Proceedings of the Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Restoration, Houston, TX, November 9-11, 1988.

Figure 1

ECC VAPOR EXTRACTION MODEL RESULTS



o Johnson, J.J., and R.J. Sterrett. "Analysis of In-Situ Soil Air Stripping Data."

Proceedings of the 5th National Conference on Hazardous Wastes and Hazardous Materials, Las Vegas, Nevada, April 19-21, 1988.

A full-scale vapor extraction system (Lisiecki and Payne, 19 was able to remove tetrachloroethene from 5,600,000 ug/kg to ug/kg, as found by soil sample analysis, in 280 days. Therefo both theoretical models and actual results show that the requiremovals will be accomplished by vapor extraction.

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APPENDIX D

CALCULATION OF SOIL VAPOR CONCENTRATIONS

APPENDIX D

CALCULATION OF SOIL VAPOR CONCENTRATIONS

The methodology to determine the soil vapor concentrations in equilibrium with Acceptable Soil Concentrations in Table 3-1 is presented below.

The soil vapor concentration of a chemical in equilibrium with the concentration in the soil particles is a function of the soil to water partition coefficient and of the air to water partition coefficient [Lyman, W.J., W.F. Reehl and D.H. Rosenblatt, "Handbook of Chemical Property Estimation Methods," McGraw-Hill, Inc., 1982].

Since not all soil moisture will be evaporated during operation of the vapor extraction system (the soil's hygroscopic water will not be removed by the anticipated operating pressures), a relationship between soil vapor and soil moisture concentrations for the site's soils can be expressed as [Ibid] =

 $C_{SV} = H \cdot C_{Sm}$

where:

 C_{SV} = concentration of compound in soil vapor, mg/l

H = Henry's Law Coefficient (nondimensional)

= <u>Vp . MW</u> S . R . T Vp = vapor pressure of compound, mm Hg

MW = molecular weight of the compound, g/gmole

s = solubility of the compound, g/cm³

R = gas law constant = $62,361 \text{ mm Hg} - \text{cm}^3/\text{gmole} + \text{OK}$

T = soil temperature = 283 OK

 C_{sm} = concentration of compound in soil moisture, mg/l

Similarly, the concentration in soil moisture in equilibrium with : the concentration in soil particles can be calculated as [Ibid] = }

$$c_{sm} = \frac{c_{sp}}{K_d}$$

where:

C_{SD} = concentration of compound in soil samples, mg/kg

Kd = soil-water partition coefficient, l/kg
 [from Appendix B, Table B6]

Combining the two equations, a relationship between soil vapor and soil samples concentration is obtained [Silka, L.R., "Simulation of the Movement of Volatile Organic Vapor Through the Unsaturated Zone as it Pertains to Soil-Gas Surveys," Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water, 1986, p.204] =

$$C_{SV} = C_{Sp} \cdot \frac{H}{K_d}$$

Table D1 presents the data and calculations of the soil vapo concentration in equilibrium with the Acceptable Concentrations in Table 3-1. None of the results shown in Tabl D1 is above the corresponding vapor saturation concentration, c the concentration in vapor in equilibrium with the pure compound The vapor saturation concentrations for the compounds in Tabl D1, assuming each compound is present by itself in the soil vapo. (i.e., molar fraction is equal to 1), are shown in Table D2. vapor saturation concentration is calculated as:

$$C_{sat} = \frac{Vp \cdot X \cdot MW}{R \cdot T} \times 10^6$$

where:

Csat = vapor saturation concentration, mg/l

X molar fraction of compound in vapor,

assumed to be 1

 $10^6 =$ factor to convert g/cm3 to mg/l

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TABLE D1 (Page 1 of 2)
SOIL VAPOR CONCENTRATIONS IN EQUILIBRIUM
WITH ACCEPTABLE SOIL CONCENTRATIONS (1)

Compound (2)	Molecular Weight (3) (g/gmole)	Vapor Pressure (3) (mm Hg)	Solubility (3)	Henry's Law Constant (4) (dimensionless)	Soil-water Partition Coefficient (5)	Acceptable Soil Concentration (6)		Vapor ration (7)
VOLATILE ORGANICS (VOCs):			•••••••	***************************************	(1/kg)	(ug/kg)	(mg/l)	ppmv
Chloroform 1,1-Dichloroethane 1,1-Dichloroethane 1,1-Dichloroethane Ethylbenzene Methylene Chloride Methyl Ethyl Ketone Methyl Isobutyl Ketone Tetrachloroethane 1,1,1-Trichloroethane 1,1,2-Trichloroethane Trichloroethane Total Xylenes ASE NEUTRAL/ACID ORGANICS: Phenol	58.1 119 99 97 106 84.9 72.1 100 166 92.1 133 133 132	270 151 182 600 7 362 77.5 6 17.8 28.1 123 30 57.9	1,000,000,000 8,200,000 5,500,000 2,250,000 152,000 20,000,000 268,000,000 17,000,000 200,000 535,000 4,400,000 4,500,000 1,100,000 198,000	0.000889 0.124 0.186 1.47 0.277 0.0871 0.00118 0.00200 0.837 0.274 0.211 0.0502 0.394 0.303	0.00071 0.116 0.076 0.086 1.75 0.022 0.00226 0.026 0.941 0.607 0.183 0.183 0.242 2.26	490 2,300 5.7 120 234,000 20 75 8,900 130 238,000 7,200 22 240 195,000	0.613 2.46 0.014 2.045 37 0.079 0.039 0.685 0.116 107 8.29 0.0060 0.39 26.2	254 496 3.39 515 9,316 22.4 13 233 16.8 36,556 2,819 1.09 71.5 4,794
	79.1	0.341	93,000,000	0.0000196	0.036	9,800	0.0053	1.36

., and .

TABLE D1 (Page 2 of 2) SOIL VAPOR CONCENTRATIONS IN EQUILIBRIUM WITH ACCEPTABLE SOIL CONCENTRATIONS (1)

NOTES:

- (1) Acceptable Soil Concentrations are determined in accordance with Footnotes 5 and 6 of Table 3-1.
- (2) Compounds above Acceptable Soil Concentrations in Table 3-1 to be removed by vapor extraction.
- (3) Data from U.S. EPA, "Superfund Public Health Evaluation Hanual," 1986,
- (4) Calculated as:

(Vapor Pressure, mm Hg) * (Molecular Weight, g/gmole) * (1,000,000 ug/g) * (1,000 cm3/t)

Henry's Law Constant (nondimensional) =

(Solublity, ug/t) * (R, mm Hg-cm3/gmole-K) * (T, K)

where: R = gas law constant = 62,361 am Hg-cm3/gmole-K; and T = soil temperature = 283 K.

- (5) From Appendix B, Table 86.
- (6) From Table 3-1.
- (7) Calculated as:

(Concentration in soil, ug/kg) * (Henry's Law Constant, nondimensional)

Concentration in soil vapor (mg/l) *

(Partition coefficient, 1/kg) * (1000 ug/mg)

Concentration in soil vapor (ppmv) = (Concentration in soil vapor, mg/l) * (1000 l/m3) / (Factor, mg/m3/ppmv)

The factors for conversion of mg/m3 to parts per million by volume (ppmv) were obtained from Vershueren, K., "Mandbook of Environmental Environmental Data on Organic Chemicals," 2nd Edition, 1983.

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TABLE D2
CALCULATION OF VAPOR SATURATION CONCENTRATIONS

	Vapor	Molecular	Vapor Saturation
	Pressure (2)	Weight (2)	Concentration (3)
Compound (1)	(em Hg)	(g/gmole)	(mg/l)
•••••••••••	• • • • • • • • • • • • • • • • • • • •	*******	
VOLATILE ORGANICS (VOCs):			
Acetone	270	58.1	888.9
Chlaroform	151	119	1018.2
1,1-Dichtoroethane	182	99	1021.0
1,1-Dichtoroethene	600	97	3297.8
Ethylbenzene	7	106	42.0
Methylene Chioride	362	84.9	1741.5
Methyl Ethyl Ketone	77.5	72.1	316.6
Methyl Isobutyl Ketone	6	100	34.0
Tetrachloroethene	17.8	166	167.4
Taluene	28.1	92.1	146.6
1,1,1-Trichloroethane	123	133	927.0
1,1,2-Trichtoroethane	30	133	226.1
Trichloroethene	57.9	132	433.1
Total Xylenes	10	106	60.1
BASE NEUTRAL/ACID ORGANICS:			
Phenol	0.341	94.1	1.8

(3) Calculated as:

Where: Csat = vapor saturation concentration, mg/l; X = motor fraction of compound in vapor, assumed to be 1; 1E+06 = factor to convert g/cm3 to mg/l; HM = motor = moto

⁽¹⁾ Compounds above Acceptable Soil Concentrations in Table 3-1 to be removed by vapor extraction,

⁽²⁾ Data from U.S. EPA, "Superfund Public Health Evaluation Hanual," 1986.